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Roentgenologic Aspects of Acute and Chronic Esophagitis[1]

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ESOPHAGITIS is a common complication of other diseases affecting the esophagus, such as carcinoma, diverticula, cardiospasm, and ulcer. In addition to these secondary forms and those due to the ingestion of caustics, there is a distinct group of inflammations, both acute and chronic, which may affect the esophagus and which are, in so far as the esophagus is concerned, the primary lesion in that organ. It is the purpose of this communication to review some of the features of these forms of esophagitis with particular reference to the roentgenologic aspects.

ETIOLOGY

The frequency of esophagitis as seen at necropsy is surprisingly high. Vinson and Butt (19) found an incidence of 7.02 per cent (213 cases) in 3,032 autopsies. Bartels (1) reported finding 82 cases of acute ulcerative esophagitis in 6,000 necropsy specimens. Our own material shows a similar high frequency in general autopsy examinations, Burke (4) recording 96 cases of acute and chronic esophageal inflammation in a series of 570 necropsies. These did not include any lesions due to caustics or associated with other diseases, such as carcinoma. Vinson and Butt emphasize the influence of vomiting and the use of the stomach tube as responsible for the increasing incidence of esophagitis. These same authors found that the esophagitis followed some form of operative procedure in 74.6 per cent of their 213 cases. In the material examined by Burke it is of interest to note that a negative suction apparatus had been used in 26 cases, frequent vomiting was a feature in 10, while in 14 a stomach tube had been passed on one or more occasions, a total of 50 cases or slightly more than half. Yet there is a striking discrepancy between this high incidence of esophagitis as found at necropsy and as seen clinically. Bartels did not believe that the use of a negative suction apparatus played much part in the causation of the inflammation in the cases reported by him and, clinically, it is extremely unusual to have significant reactions develop from its use. Wangensteen (20) stated that he had seen no ill effects from its use in over 5,000 examinations. Bartels was of the opinion that acute ulcerative esophagitis as seen at necropsy is distinctly related to vomiting or even nausea without vomiting, with relaxation of the cardiac sphincter permitting gastric juice to come into contact with the esophageal mucosa; that it seems necessary that the patient should be debilitated but not necessarily dying before changes can

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occur in the esophagus. These states imply a slowing of the circulation of the lower portion of the esophagus which normally is poor and therefore a loss of normal resistance of the tissues to trauma. Normally, as is known, the esophagus has a good ability to repair any area that is traumatized. While Bartels admits that there is an increasing prevalence in autopsy material he has no explanation to offer for it.

Selye (17) was able to produce a condition resembling peptic hemorrhagic esophagitis in rats by ligating the pylorus, thereby causing an accumulation of gastric juice with regurgitation into the esophagus.

Bloch (3) reported a series of cases of acute ulcerative esophagitis. He was unable to establish a definite etiologic factor but pointed out the possible relationship of vomiting and the use of the stomach tube. He also suggested that shock might play a part, since many of the lesions are found in patients dying postoperatively after serious abdominal operations. In his series there was a nearly complete absence of clinical symptoms that might be related to the esophagitis. Vomiting with blood streaking was encountered occasionally, but even in those patients with severe ulcerative lesions, obstruction with symptoms of dysphagia was not observed, and he was of the opinion that there was no way to diagnose the very acute form of esophagitis in the living, the patients being too ill, as a rule, for endoscopic examination.

Mosher (14) believed that both acute and chronic esophagitis can result from a wide variety of infections arising either within or without the esophagus. He states that infection may be carried to the esophagus from sources within the abdomen by way of the lymphatics. Thus chronic cholecystitis, chronic appendicitis, duodenal ulcer, and diseases of the liver are frequent sources of chronic esophageal infection. As causative factors for acute esophagitis he includes pneumonia, general peritonitis, infectious thrombophlebitis, and any hematogenous infection.

It is to be emphasized that most of the reports dealing with any reasonably large series of cases of esophagitis are based upon necropsy material. Clinical experience would indicate that either acute or chronic esophagitis of sufficient severity to be the cause of significant symptoms, while not rare, is unusual. Gray and Sharpe (8) state that acute esophagitis is relatively common as a transient manifestation of the damage done by ingested caustics, alcohol, or any trauma. In their experience most forms of esophagitis, excluding the agonal cases, are seen but rarely, the most common type being acute ulcerative esophagitis, the cause of which is uncertain. Chronic esophagitis, according to them, is usually only part of a syndrome of gastric disease found among persons suffering from chronic alcoholism and those addicted to eating highly seasoned and very hot foods.

Others (2, 11, 12, 18) have reported instances of acute ulcerative esophagitis following duodenal ulcer, frequently developing after operative procedures for the correction of the ulcer. The lesion seems to be the same as that found at autopsy except that the patient survives the original disease and as a result the esophagitis is likely to produce a fibrous stricture. The suggestion has been offered that many of the benign strictures found at esophagoscopy in the lower end of the esophagus are the end-results of previous esophagitis.

Chamberlin (5) noted the important relationship of peptic ulcer of the esophagus and esophageal hiatal hernia. Six of 7 patients with such an ulcer had either a short esophagus, diaphragmatic hernia, or both. This suggests a cause for patency of the cardia, usually given as one of the essentials for the production of peptic ulcer of the esophagus (the other being heterotopic gastric mucosa). A congenitally short esophagus or an acquired esophageal hiatus hernia may likewise be a factor in the development of diffuse esophagitis, and for the same reason, *i.e.*, free regurgitation of acid gastric contents into the esophagus through a patent cardia (10).

SYMPTOMS

The most significant symptoms of esophagitis, according to Vinson and Butt, are, in the order of frequency, substernal pain, dysphagia, and hematemesis. In terminal cases Bloch found a striking absence of symptoms except for vomiting with blood streaking. In the chronic lesions, dysphagia and substernal pain are most frequently recorded. In our own clinical material, difficulty in swallowing has been the major complaint in both the acute and chronic cases.

ROENTGENOLOGIC ASPECTS

Otell and Coe (15) report that in acute esophagitis there is no variation from the normal in the roentgen appearance; that chronic esophagitis cannot be recognized roentgenologically and can only be surmised as a possible etiologic factor in stenosing lesions of the esophagus.

Holmes and Schatzki (9) state that broadening of the rugae indicates inflammation of the esophagus. Vinson and Butt emphasize that spasm is a prominent feature but that the severity of the spasm does not appear to depend upon the degree of inflammation.

Winkelstein (21) reported a series of cases, designated by him as peptic esophagitis, which revealed striking roentgenologic findings in the form of irregular spasm and narrowing of the lower third or half of the esophagus. On esophagoscopic examination inflammation was seen and in all cases biopsy specimens revealed varying degrees of esophagitis. He thought the lesion was a distinct entity. At about the same time Moersch and Camp (13) reported a series of similar cases under the title "Diffuse Spasm of the Lower Part of the Esophagus." The clinical and roentgenologic appearances were the same and Moersch, in discussing Winkelstein's paper, agreed that they probably represented the same lesion. Moersch and Camp suggested the possibility of a neurogenic origin for this lesion, since many of the patients showed nervous instability. They also suggested that chronic infection might be responsible, carried to the esophagus by the lymphatics from sources within the abdomen, as indicated by Mosher. The cause of this lesion still is unsettled.

Faulkner and associates (6, 7) reported cases of esophageal spasm which showed a definite relationship to psychic factors. Spasm, as seen through the esophagoscope, could be influenced by pleasant or unpleasant suggestions. The spasm could be increased by suggestions that called forth such emotions as grief, anger, and anxiety, and relaxed by eliciting such emotions as happiness, contentment, and elation. Whether these investigators were dealing with the same type of lesion as reported by Winkelstein and others is uncertain. In Winkelstein's cases biopsy revealed inflammation. Perhaps the spasm is the primary lesion and the chronic inflammation secondary to the long continued spasm and resulting stasis.

REPORT OF CASES

The following cases serve to illustrate some of the clinical and roentgenologic features as observed by us:

CASE 1: *Acute Ulcerative Esophagitis:* A white male, 58 years of age, had had a cholecystotomy elsewhere three months prior to entering this hospital. Postoperatively he continued to have abdominal pain, vomiting, and tarry stools. Examination on admission revealed a fluctuant swelling in the region of the wound. On incision this drained bile and pus. Roentgen examination of the gastrointestinal tract demonstrated a fistula between the duodenum and the biliary passages with reflux of barium into the biliary duct system. Laparotomy confirmed the presence of a fistula between the duodenum and the gallbladder with extensive adhesions around these structures, a possible stone in the common duct, and a mass (inflammatory?) in the region of the head of the pancreas. Because of the extensive adhesions and the general condition of the patient, only a posterior gastro-enterostomy was done. Postoperatively a negative pressure tube was left in the esophagus for a week. After this was removed the patient complained of difficulty in swallowing. Roentgen examination showed diffuse spasm of the lower esophagus, loss of normal mucosal folds, a fine roughening of the margins, and considerable obstruction (Fig. 1A). These changes were interpreted as evidence of acute ulcerative esophagitis. The difficulty in swallowing increased and esophagoscopic

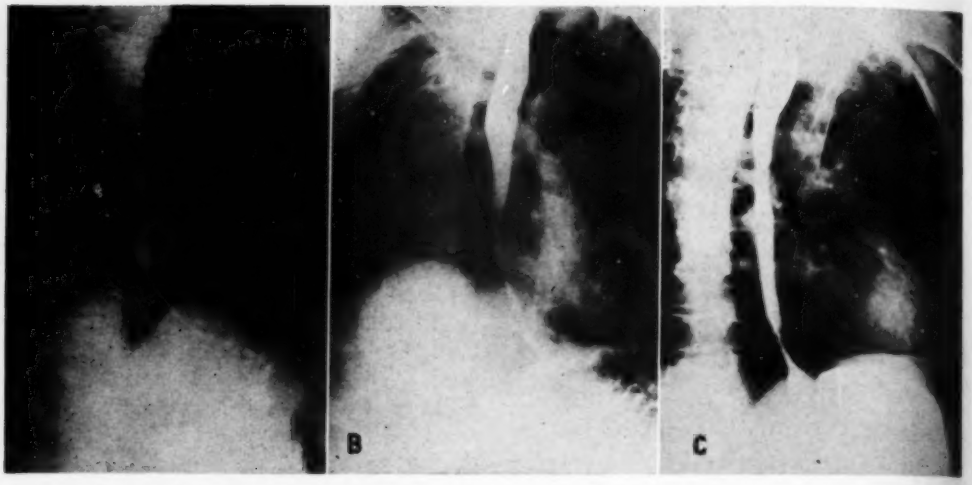

Fig. 1. Case 1: Acute ulcerative esophagitis. A. Appearance during the acute phase of the infection. The diffuse narrowing of the distal end of the esophagus was constant. No mucosal folds are apparent, and the margins show a fine roughening. B. Nine months later. The lesion has progressed to a fibrous stricture. C. Appearance three years after onset and after numerous esophageal dilatations. Patient symptomatically improved.

examination demonstrated granulation tissue and a diffuse stricture in the lower end of the esophagus (Fig. 1B). Subsequently numerous esophageal dilatations were performed and at the last examination, six years later, the patient was able to eat without difficulty (Fig. 1C).

Comment: This case is fairly typical of a small group in which, generally following some operative procedure on the stomach or duodenum, an acute ulcerative inflammation involving the lower part of the esophagus develops during the immediate postoperative period. In this instance a number of factors may have been responsible, including the presence of upper abdominal infection, the trauma and shock of the operation, the vomiting prior to operation and, finally, the presence of a tube in the esophagus for a period of one week following operation. The roentgen evidence consisted of severe spasm of the lower half of the esophagus, producing a uniform narrowing in caliber, a complete loss of mucosal markings, and a fine granular roughening of the surfaces indicating a diffuse ulcerative process. The lesion progressed to fibrous stricture, which was eventually relieved by repeated dilatations.

CASE 2: *Acute Ulcerative Esophagitis:* A 41-year-old white male had been operated upon elsewhere six weeks previously for a ruptured peptic ulcer. While recovering, he noticed some difficulty in swallowing. The record does not mention the use of a tube or the occurrence of vomiting postoperatively. After discharge, several weeks prior to admission to the State of Wisconsin General Hospital, the dysphagia became worse and there was some substernal pain on swallowing. Roentgen examination at the time of admission (Fig. 2) revealed the lower third of the esophagus to be diffusely narrowed, with rather pronounced delay in the passage of the meal through the involved area. No normal mucosal folds could be seen. The stomach was slightly enlarged. The duodenal bulb was deformed, with a small ulcer crater present. Esophageal dilatation was attempted but was unsuccessful. Because of increasing obstruction, evident both clinically and roentgenologically, gastrostomy was performed. Convalescence from this operation was uneventful, the patient was discharged, and has failed to return for further observation.

Comment: This case is similar to the previous one in that progressive lower esophageal obstruction developed during the period of convalescence following operation for a ruptured duodenal ulcer. The lesion progressed rapidly to practically complete obstruction, probably due to fibrosis, and gastrostomy was necessary. It seems probable that an acute

ulcerative esophagitis occurred postoperatively, progressing to a fibrous stricture.

CASE 3: *Chronic Esophagitis*: A 73-year-old white male had complained of difficulty in swallowing for about one year. This had become progressively worse until at the time of admission to this hospital he could swallow only liquids. There was no actual

Fig. 2. Case 2: Acute ulcerative esophagitis. Pronounced narrowing of lower half of esophagus, due in part at least to spasm. Occasionally this would relax slightly, under fluoroscopic observation, allowing some of the meal to enter the stomach. Later the deformity became completely fixed and the obstruction complete.

pain and no vomiting except for the regurgitation of swallowed food which would not pass. Esophageal dilatation had been done by the patient's physician several days prior to admission and this gave some relief. There had been a weight loss of ten pounds in six weeks. Additional complaints included serious loss of vision, deafness of the right ear, slight exertional dyspnea, and formerly a right upper quadrant pain, which had been relieved by a gallbladder type of diet. Roentgen examination of the gastrointestinal tract showed the presence of a congenitally short esophagus with an esophageal hiatus hernia; the lower third of the esophagus was diffusely narrowed; the duodenal bulb was deformed, without a visible crater. It was concluded that the patient had a benign stricture of the esophagus secondary to a chronic esophagitis (Fig. 3). Treatment consisted

Fig. 3. Case 3: Chronic esophagitis with fibrous stricture of the lower esophagus, short esophagus, and esophageal hiatus hernia.

of esophageal dilatation. Following this the patient began to have fever and an increased pulse and respiratory rate. Roentgenograms of the chest demonstrated patchy consolidation at the left base and, later, the development of pleural effusion. The condition became progressively worse and death occurred three and a half weeks after admission.

At autopsy the findings with reference to the esophagus and adjacent mediastinal structures were reported as follows: "A small portion of the fundus of the stomach is herniated through the hiatus of the diaphragm (which is unusually large) and lies in the posterior mediastinum. Just above the junction of the esophagus and stomach (approximately 4 cm. above the diaphragm) there is a stricture of the esophagus by what appears to be a band of fibrous tissue in the wall. Just outside of the junction of the esophagus and stomach there is a small, fairly well walled-off abscess in the posterior mediastinum. This abscess is continuous with an empyema cavity adjacent to the left lower lobe." Microscopically the esophagus was "greatly thickened with fibrous tissue at the point of stricture. The mucosa is destroyed by chronic inflammatory reaction which extends through all layers of the wall. Old blood pigment is present in the wall. In some areas of the esophageal wall there are groups of polymor-

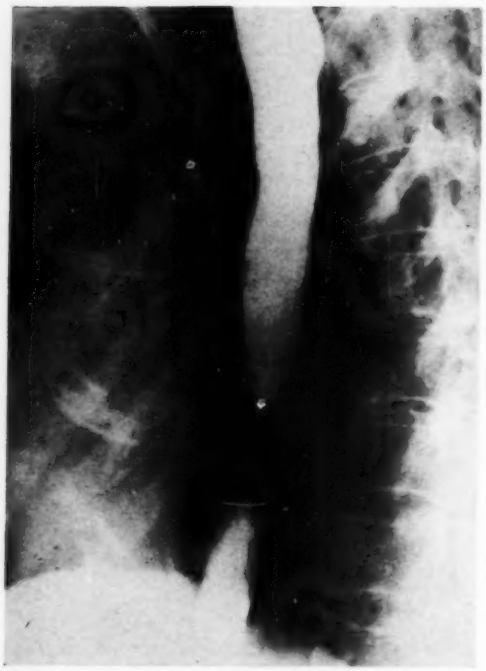

Fig. 4. Case 4: Benign fibrous stricture of the esophagus.

phonuclear leucocytes." The anatomical diagnosis included (1) herniation of the fundus of the stomach through the diaphragm, (2) fibrous stricture of the esophagus, (3) acute and chronic esophagitis.

Comment: A review of the clinical and roentgenological data in the light of the autopsy findings suggests that this patient had a congenitally short esophagus with an esophageal hiatus hernia; that a chronic esophagitis developed, leading to a fibrous stricture, possibly as a result of regurgitation of acid gastric contents through a patent cardia. The terminal picture was one of acute periesophageal and pleural infection developing after mechanical dilatation of the esophagus.

CASE 4: *Chronic Fibrous Stricture of the Esophagus:* The patient, a white female 61 years of age, complained of inability to eat and retain fluids or solids. The difficulty had its onset three years previously and of late had been worse. There had been loss of weight and progressive weakness, but no nausea or vomiting. The clinical impression was a probable carcinoma of the esophagus. Roentgen examination (Fig. 4) demonstrated a benign stricture in the lower third of the esophagus, an hourglass type of stomach due to a large saddle ulcer on the lesser curvature of the middle third, and evidence of extensive perigastric adhesions, with the pylorus pulled up and adherent to the area of ulceration. Esophagoscopy revealed a benign stricture in the lower esophagus. The roentgen findings with reference to the stomach were confirmed at laparotomy; the adhesions were freed and the ulcer was excised.

The patient was readmitted eight months later, complaining of epigastric pain occurring intermittently with occasional nausea and vomiting. At operation a large recurrent ulcer was found. Since resection was impossible, the ulcer was closed with sutures and a posterior gastro-enterostomy was performed. The gallbladder was found to be full of stones but was not removed. Postoperatively, dysphagia developed. This was relieved by esophageal dilatation, and convalescence thereafter was uneventful.

Comment: In spite of the extensive gastric disease, this patient's primary complaints were referable to the esophagus. The stricture may well have been the result of previous esophagitis or ulcer, the possibility of such a process being heightened by the findings in the stomach. As shown by Mosher, the esophagus exhibits a pronounced tendency toward fibrosis when involved by infection, and a gastric ulcer may well be a source for such infection.

CASE 5: *Chronic Esophagitis or Diffuse Spasm of the Esophagus:* The patient was a female of 52 who had difficulty in swallowing of three years' duration. She had been given atropine, but with only slight relief. Esophageal dilatations had been attempted but her co-operation was poor, and they were not successful. The patient had many worries, financial and personal, and was of a nervous type. There had been a considerable weight loss, from 150 to 78 pounds. Esophagoscopy revealed a marked contraction of the lower end of the esophagus with scarring of the mucous membrane, which bled easily. There was no actual ulceration. Roentgen examination (Fig. 5) showed diffuse, intermittent spasm of the lower half of the esophagus. Another attempt at esophageal dilatation was successful, following which the patient was considerably improved.

Comment: This case is illustrative of the type of lesion described by Winkelstein as peptic esophagitis and by Moersch and Camp as diffuse spasm of the esophagus. Clinically, the patients often are considered as having cardiospasm, but the

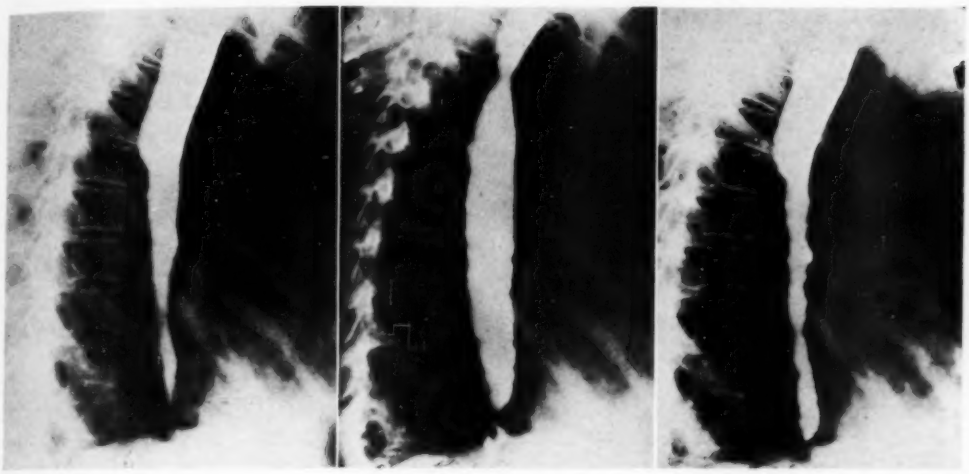

Fig. 5. Case 5: Chronic esophagitis or diffuse spasm of the lower half of the esophagus. Serial roentgenograms illustrate the rapidly changing spastic manifestations.

roentgenologic and esophagoscopic appearances are distinctly different. In our experience the lesion has been relatively uncommon, a total of seven cases having been observed during the past six years. The etiology is still a matter of conjecture, but chronic inflammation seems to be present quite uniformly.

DISCUSSION

From a summary of the reports in the literature and on the basis of our own experience, the following facts stand out: (1) Acute ulcerative esophagitis is common in necropsy specimens but is unusual in clinical practice, suggesting that there must be a pronounced lowering of the resistance of the tissues before it can develop. (2) While mild forms of esophagitis may be relatively common, they are transient and seldom responsible for serious disturbance. (3) The etiology of acute ulcerative esophagitis is uncertain. A number of factors seem important, including relaxation of the cardia, permitting gastric juice to come into contact with the esophageal mucosa, frequent vomiting, and the use of the stomach tube, and the trauma and shock associated with upper abdominal operations. Since more than one or all of these factors may be present in the individual case, it is almost impossible to determine which plays the greater part. (4) Clinically, the use of a negative suction apparatus has seldom if ever, in itself, been responsible for the production of acute esophagitis if the patient survived the disease for which he was being treated. (5) Clinical ulcerative esophagitis is seen most commonly in association with peptic ulcer, particularly duodenal ulcer, often after operative procedures for the relief of the ulcer. The lesion tends to progress to fibrosis and stricture. Benign stricture of the lower end of the esophagus without other obvious cause may often be the end-result of previous esophagitis. (6) Chronic esophagitis also is uncommon clinically. It may represent an active chronic infection or be only the fibrous residue of previous infection. (7) Diffuse spasm of the lower end of the esophagus may be a manifestation of chronic esophagitis, although the cause is not fully understood

The roentgenologic findings in acute ulcerative esophagitis when the lesion is observed during the course of its development may be listed as follows: (1) The lesion is largely confined to the lower third or half of the esophagus. (2) The earliest evidence is that of spasm, which may be intermittent but usually is severe. (3)

Within a short time, often a matter of only several weeks, the deformity becomes fixed, probably due to fibrosis leading to diffuse narrowing, which gradually increases toward the cardia. Peristalsis is completely absent through the involved region and obstruction is pronounced. (4) There is an absence of normal mucosal folds through the contracted area, and the margins are finely irregular. (5) The lesion may progress to complete stenosis.

The roentgen differential diagnosis is not difficult. The occurrence of this lesion during the immediate postoperative period in patients who have had some type of surgical procedure for the correction of gastric or duodenal ulcer has been noted sufficiently often to suggest more than a casual relationship. The frequently associated episodes of vomiting and the use of the stomach tube or negative suction apparatus, preoperatively and postoperatively, are probably related etiologic factors. When dysphagia develops in such a patient and roentgen examination shows changes as described above, the diagnosis can be made with considerable certainty. It is obvious that the roentgen appearance will resemble closely that seen in ulcerative esophagitis following the ingestion of caustics. Chemical esophagitis is not so likely to be limited to the lower end of the esophagus, the lesion tending to be most severe at the points of anatomical narrowing and to skip other areas, producing a much more irregular stricture. The history, of course, will often be the deciding factor in establishing the etiology. The differentiation from carcinoma should be readily made. The length of the constriction and the lack of sharp demarcation from the normal wall should be sufficient to rule out cancer.

Chronic esophagitis may be only the fibrous residue of a previous acute esophagitis or may be an active chronic infection (Case 3). In the former instance, the roentgen appearances are those of a smooth constriction of variable length, without sharp demarcation at either end, located in the lower portion of the esophagus. The lumen through the stricture is fixed and the walls are rigid. Spastic manifestations are absent. Evidence of active or healed gastric or duodenal ulceration may be elicited. In active chronic infections sufficient fibrosis may have developed so that the same type of deformity may be produced. In other instances, the most prominent feature is intermittent spastic narrowing of the lower third or half. The spasm is best demonstrated by roentgenoscopy. The rapid alterations in form are striking. At times the spasm may relax so that the lumen becomes of normal width, but this relaxation is only momentary. Normal peristalsis is not observed, but rapid up-and-down movements and, at times, a tetanic type of contraction occur. During the contraction phase, the mucosal folds appear distinctly thickened but pursue a normal longitudinal course. The presence of mucosal folds and the marked variation in the spastic phenomena during a short period of time are features which serve to distinguish this lesion from the acute ulcerative form. The duration of symptoms is likely to be longer. Esophagoscopy will confirm the presence of spasm, and areas of scarring or active inflammation may be seen. It is possible that this lesion is entirely neurogenic in origin, with the inflammatory changes secondary to chronic stasis, but since they seem to be present so frequently we have followed Winkelstein and designate it as chronic esophagitis.

SUMMARY AND CONCLUSIONS

1. Acute ulcerative esophagitis is a lesion frequently seen at necropsy but is rather uncommon as a clinical disease, suggesting that there must be a pronounced lowering of general resistance before it can develop.

2. Clinically, acute ulcerative esophagitis is most often associated with peptic ulcer or develops during the immediate period following upper abdominal operations. Anything which tends to cause relaxation of the cardia, permitting acid gastric juice to come into contact with the

esophageal mucosa, may predispose to its development. Frequent vomiting is an important factor. The use of a negative suction apparatus in itself is of questionable importance but may play a part when additional causes are present.

3. The roentgen changes consist of severe spasm of the distal part of the esophagus, loss of mucosal folds, and a fine roughening of surfaces. The lesion tends to progress to a fibrous stricture.

4. Chronic esophagitis of sufficient severity to be the cause of symptoms is also uncommon. If it is present for a sufficient length of time, the roentgen findings may be those of a diffuse fibrous stricture, since the esophagus shows a great tendency for the development of fibrosis when involved by infection.

5. In other instances of chronic esophagitis, the most striking roentgenologic manifestation is intermittent, diffuse spasm of the lower half or third, with thickening of the mucosal folds.

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DISCUSSION

Frederic E. Templeton, M.D. (Chicago, Ill.): The Society is indebted to Doctor Paul for a clear and concise picture of a lesion which has several names—acute ulcerative esophagitis, peptic esophagitis, chronic non-specific esophagitis.

There is a discrepancy between the frequency with which this lesion is seen on pathologic examination and on roentgen examination. The gastroscopist reports chronic non-specific gastritis in a much higher number of cases than does the roentgenologist, just as chronic non-specific colitis is reported in a much higher frequency by the proctoscopist than by the roentgenologist. I suggest one explanation for the discrepancy. We know that gastritis may involve only the mucosa and not the submucosa. When this happens, the condition cannot be identified roentgenologically. I believe the same thing holds true in ulcerative colitis and esophagitis.

We prefer to use only the anatomical signs for diagnosis of esophageal inflammations. These are a thickening of the mucosal folds, shallow ulceration, and stricture. We are not convinced that the spastic phenomena are diagnostic of these lesions. Physiologists have described three types of contractions of the esophagus: the primary peristaltic wave, initiated by the act of deglutition; the secondary peristaltic wave, which may arise anywhere within the esophagus; the tertiary or local contractions. The tertiary contractions, sometimes referred to as "curling," are seen in many patients past middle age. The lower half of the esophagus undergoes a diffuse, irregular, momentary type of contraction. Some authors have suggested that this form of contraction is a sign of esophagitis. Four cases which we

observed underwent postmortem examination. In none was a diffuse inflammation observed. It may be that the inflammation sets up this type of contraction, but we do not know whether or not this is incidental.

There is another reason why esophagitis is observed more frequently on pathological examination. Doctor Paul pointed out that vomiting, which washes the mucosa with acid gastric juice, probably gives rise to this lesion. Many patients in the terminal stages of disease suffer from vomiting. It may be that much of the esophagitis seen by the pathologist is a terminal process. We do not, therefore, have a chance to see this lesion roentgenologically, since roentgen examination is contraindicated.

Some European investigators have suggested that chronic, non-specific gastritis is a forerunner of gastric ulcer and carcinoma. It may be that chronic, non-specific esophagitis holds the same relationship to peptic ulcer and carcinoma of the esophagus. Perhaps we may have to revise our thinking, and look upon carcinoma and peptic ulcers of the esophagus as complications of esophagitis, rather than esophagitis as a complication of peptic ulcer and carcinoma.

Lester W. Paul, M.D. (*closing*): Perhaps I should have emphasized that I do not believe that the lesion designated as peptic esophagitis or as chronic spasm of the esophagus is the same as that seen in old age, described as "curling." To me these seem to be entirely different lesions.

Chronic spasm of the esophagus or peptic esophagitis is a diffuse process and, when the contraction occurs, it does so quite uniformly throughout the length of the involved segment. While occasional concentric contractions appear, they are only momentary and the esophagus then undergoes multiple types of spastic irregularity. Curling is a phenomenon which is elicited much more commonly when the examination is done with the patient in a recumbent position and may not be seen when he is upright. The other lesions are seen regardless of the position assumed. While both may be neurogenic in origin, they do produce different roentgenologic effects.

Roentgenological Manifestations of Pleuropulmonary Involvement in Tularemia[1]

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SINCE tularemia was first described in man by Edward Francis (1) in 1922, more than 12,000 cases have been reported. On the basis of these reports a great deal has been learned about the geographical distribution, clinical course, and symptoms of the disease. It has been found in every state of the Union and in Canada, the greatest number of cases being reported from mid-western states, especially Illinois and Missouri.

The disease is transmitted to man most often by contact with infected rabbits and other rodents, and by fowl and tick bites. It can be conveyed through the unbroken skin and eye by contact with infected material. Cases have also been recorded resulting from eating insufficiently cooked meat from infected animals. In 1933 Winter, Farrand, and Herman (2) reported a group of cases seen in the spring, during the lambing season. All were associated with the handling of sheep and with tick bites. It was thought that the unusually wet spring made handling of the animals more hazardous and that the disease in these cases was most likely due to contact with tick excreta in the wet wool.

In general the mortality of tularemia is estimated to be about 5 or 6 per cent. The mortality rate rises sharply, however, with pleuropulmonary complications. In 1924, Verbrycke (3) reported a pneumonic process in this disease. Sante (4) was the first to demonstrate pulmonary involvement roentgenographically, in 1930. Relatively little attention has been paid, however, to the pulmonary manifestations of the disease, from the roentgenologist's point of view. It is our purpose to present the roentgenographic findings in cases with pleuropulmonary manifestations seen in a series admitted to the St. Louis City Hospital and St. Mary's Hospital, in the past five years, with a diagnosis of tularemia. This series included a total of 81 cases. The criteria for a diagnosis of tularemia were a history of contact, positive agglutination titers of 1:160 and higher or a rising titer, and recovery of the organism following guinea-pig inoculation in several isolated cases. The mortality rate for this group was 9.7 per cent. In all except one of the fatal cases, some type of pulmonary complication was confirmed by roentgenogram, autopsy, or both.

Complaints referable to the chest are frequently overlooked on account of severe local disease and the toxic state of the patient. We found that 36 of our series had symptoms referable to the chest, such as pain, cough, expectoration, and dyspnea; in only 29 of this group were chest roentgenograms made. In 2 cases, bronchopneumonic complications were recognized on roentgenograms taken routinely in patients having no physical findings characteristic of pneumonia and no chest symptoms.

The four recognized clinical forms of tularemia have been so completely described that further description is unnecessary here beyond mentioning the various types (5).

(A) The *ulcero-glandular*, which is the most common form, has a papular primary lesion which later becomes an ulcer associated with regional adenopathy.

(B) In the *glandular* type there is regional adenopathy without evidence of the primary lesion.

(C) The *oculo-glandular* type shows a primary conjunctivitis, with secondary regional adenopathy.

[1] Presented before the Radiological Society of North America, at the Twenty-eihgth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

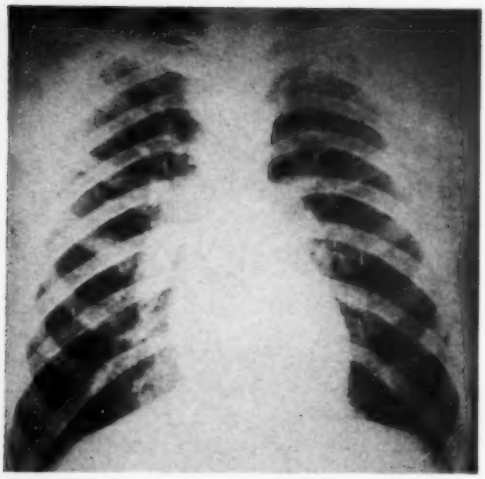

Fig. 1. Case 1 (A. D.): Roentgenogram two days after admission, showing hilar adenopathy without parenchymal involvement.

(D) The *typhoidal* type has no primary lesion or regional adenopathy, but presents a clinical picture of profound toxicity.

Roentgenographic analysis in our series of 81 cases led to a division into two groups. The first group consisted of 72 cases of the ulcero-glandular, glandular, and oculo-glandular types; the second of 9 cases of the typhoidal type.

Of the 72 patients which composed the first group, 27 had symptoms or physical findings referable to the chest. In 19 of these there was roentgenologic evidence of pulmonary involvement, beginning with hilar adenopathy. In 14 parenchymal involvement subsequently developed; only one of this group of cases was complicated by pleural effusion. There were 2 cases without chest symptoms that showed evidence of hilar adenopathy with a patchy parenchymal involvement on roentgenograms taken routinely. In the group of 19 cases showing pleuropulmonary involvement there were 4 deaths, whereas there was but a single death from septicemia in the 53 cases which did not show pulmonary lesions.

In patients with pleuropulmonary involvement, the most consistent roentgen findings in the chest were enlarged and nodular hilum shadows, which usually occurred early in the disease. These were often not recognized as an important entity until accentuation of the lung markings radiating to the periphery developed.

The following are illustrative cases of pleuropulmonary involvement in this first group.

CASE I: A. D., white male, 22 years old, was admitted to the City Hospital, Dec. 31, 1939. His illness began about ten days after he had dressed rabbits. Ulcers first appeared on the dorsum of the

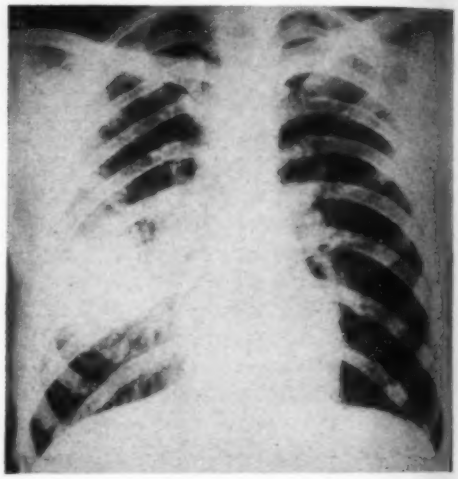

Fig. 2. Case 1 (A. D.): Examination ten days after admission reveals consolidation in the middle third of the right lung field, evidence of parenchymal extension from the hilar region.

right hand, followed later by a large swelling in the right axillary region. Several days later chills and fever developed, but the patient never complained of pain in the chest and at no time had any cough.

There was a large ulceration on the dorsum of the right hand and enlarged lymph nodes were present in the right axilla. Respirations were rapid and the temperature was elevated. Examination of the chest failed to show evidence of disease. The white blood count was 10,200; hemoglobin 98 per cent. Blood agglutination tests with *B. tularense* were at first negative. In view of the classical picture, however, a diagnosis of tularemia was made and the patient was placed on supportive therapy.

Roentgenograms of the chest two days after admission revealed enlarged hilar lymph nodes but no evidence of parenchymatous involvement. Further roentgen examination, on the tenth day after admission, showed an area of consolidation extending from the right hilus into the right middle lobe, which

was suggestive of an atypical inflammatory process. Blood agglutination tests at this time were positive for *B. tularense* with a titer of 1:160. On the 13th hospital day definite areas of increased density in the right middle lobe were demonstrable in posterior-anterior and right lateral views. Further examination, four days later, revealed consolidation of this lobe. Two months after admission, the area of consolidation in the right middle lobe was decreasing in size, indicating that the process was undergoing slow resolution. The patient was discharged March 4, 1940.

CASE II: B. K., male, 25 years old, was admitted Nov. 15, 1939. Ten days previously he had killed a rabbit and skinned it. A week later general malaise developed, with chills and fever. These symptoms progressed until the patient became delirious four hours before admission. Two days before admission he noticed a boil at the base of the nail of his index finger and some sore lumps in the left axilla and above the elbow. On admission he was acutely ill and disoriented. The temperature was 104° F., the pulse 110, and respirations 30 per minute. In the left axilla were several large, tender, soft nodes. The epitrochlear node was greatly enlarged and the nodes in the right axilla and inguinal regions were also enlarged but less tender. The urine was normal; the white blood count on admission was 6,100. Blood agglutination with *B. tularense* was 1:51,000.

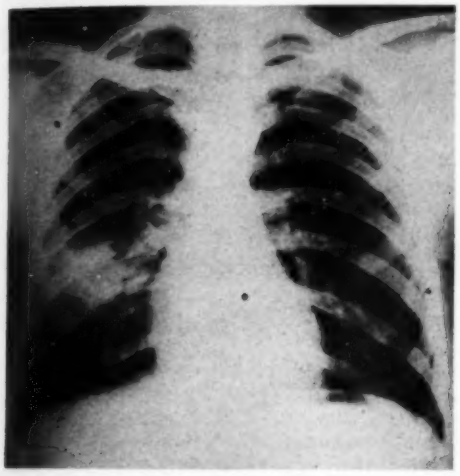

Fig. 3. Case 1 (A. D.): Re-examination one month after admission shows area of consolidation diminishing. Patient showed definite improvement.

Roentgenograms of the chest two days after admission revealed heavy hilar shadows bilaterally, with an increase in the lung markings extending outward from the hilar regions. There was, however, no evidence of infiltration or consolidation or other sign of parenchymatous involvement in either lung. Re-examination one week later still showed heavy hilar shadows and lung markings bilaterally. The patient responded well to general supportive measures and was discharged in an improved condition on Dec. 3, 1939.

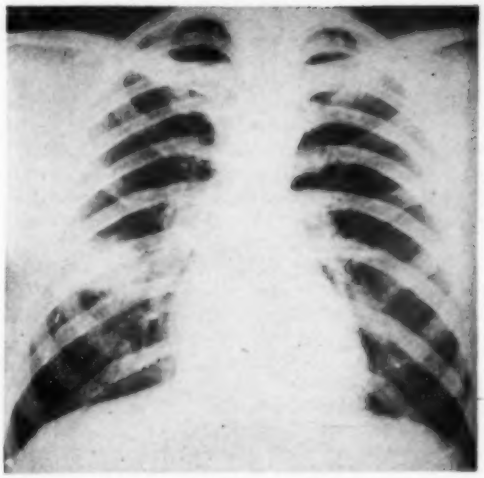

Fig. 4. Case 1 (A. D.): Two months after admission, roentgen examination showed consolidation on the right definitely undergoing resolution.

CASE III: F. P., a 54-year-old white male, was admitted to City Hospital Dec. 24, 1936, in an irrational state. About two weeks previously he had dressed a rabbit, after which an ulcer developed at the base of his right thumb. This was followed in three days by swelling and tenderness in the right axilla. Chills and fever then developed, followed by a productive cough. Four days before entrance to the hospital the patient became irrational.

The temperature on admission was 103.2° F., pulse 134, and respirations 30 per minute. The white blood count was 5,800 and blood agglutination with *B. tularense* was 1:320. There was a small ulcer in the fold of the skin at the base of the right thumb and large and tender lymph nodes were palpable in the right axilla.

Roentgen examination of the chest the day following admission revealed an irregular consolidation in the base of the right lung. The patient did not respond to treatment and died two days after admission.

At necropsy the large palpable lymph nodes in the right axilla showed, microscopically, an area of necrosis in the center surrounded by a zone of polymorphonuclear leukocytes and lymphocytes. The lungs showed several areas of consolidation in both bases. On section, these areas were dark red in color. Microscopically the alveoli were seen to be filled with red blood cells and an inflammatory exudate. There were large areas of necrosis of the

alveolar walls and marked dilatation of the blood vessels.

CASE IV: E. M., 49-year-old white male, was admitted to St. Mary's Hospital Dec. 19, 1938, complaining of an ulcer on the middle finger of the right hand and swollen nodes in the right axilla. Approximately three weeks before admission, he had cleaned and dressed some rabbits. Shortly after this, the ulcer on the right hand had appeared, followed by swelling of the axillary lymph nodes and severe malaise and fever.

On physical examination, the patient appeared extremely toxic, cyanotic, and dyspneic. The ulcer on the right hand measured about 4 cm. in diameter and the axillary lymph nodes were greatly enlarged, discrete, soft, and tender. Chest examination revealed signs of consolidation in the right lower lobe. The white blood count on the day of admission was 13,800. Agglutination tests with *B. tularense* were negative at this time.

Roentgenograms made on admission revealed accentuation of the hilar shadows and peribronchial infiltrations in the right base. Subsequent examination, fifteen days later, showed the inflammatory process in the right lower lobe to have spread, with associated pleural effusion. At this time, blood agglutination with *B. tularense* was 1:200.

The patient died eighteen days after admission. About 700 c.c. of thin yellow fluid were obtained from the right pleural cavity. The right lower lobe was firm and consolidated and microscopic examination showed the alveoli to be filled with an inflammatory exudate containing polymorphonuclear leukocytes, lymphocytes, and monocytes. There were also many small areas of necrosis. The right axillary and mediastinal lymph nodes were enlarged. Microscopically they showed multiple areas of necrosis. The liver and spleen were enlarged and appeared congested. These areas also showed focal necrosis and abscess formation microscopically.

CASE V: G. M., 55-year-old white male, was admitted to St. Mary's Hospital Dec. 10, 1938, complaining of a cut on his left index finger, chills, fever, cough, and labored respiration. About fifteen days before admission, he had skinned and dressed a rabbit. After this a sore appeared on his left index finger, followed by swelling and tenderness of the left axillary nodes. Subsequently chills, fever, severe prostration, and cough developed.

Physical examination showed the patient to be in a severely toxic state, with cyanosis and dyspnea. He had an ulcer on his left index finger and greatly enlarged left axillary lymph nodes. Examination of the chest revealed signs of consolidation over the left upper lobe, confirmed roentgenographically.

The white blood count on admission was 16,000. The patient did not respond to treatment and died five days after admission.

Necropsy revealed consolidation of the left upper lobe; cut section showed severe congestion and deep red discoloration. Microscopic studies revealed inflammatory exudate in all of the alveoli. The lymph nodes of the left axilla and mediastinum were enlarged and microscopic examination showed a coalescent type of focal necrosis.

Analysis of the roentgen findings in this group of cases shows hilar enlargement due to involvement of the tracheobronchial lymph nodes in the early stages of the disease, with later extension into the parenchyma by retrograde spread *via* the lymph channels.

In the second group, consisting of 9 cases of typhoidal tularemia, chest symptoms and roentgen evidence of hilar adenopathy were present in all. Seven of the patients had pneumonia, in one instance complicated by abscess formation. Of these 7 patients, 3 died. The most consistent roentgen findings in the chest were early parenchymal involvement, usually without enlarged hilar nodes, and later consolidation of one or more lobes with or without abscess formation.

The following cases illustrate this type of pulmonary involvement.

CASE VI: B. W., white male, aged 24 years, was admitted to the hospital Dec. 21, 1941, with chills, fever, cough, and diarrhea. The onset of his present illness dated back about twelve days. He first complained of a severe headache for several days; diarrhea then developed, and he had his first chill and fever. These symptoms lasted for several days. Three days prior to admission to the hospital a productive cough occurred with expectoration of a thick, purulent sputum and another severe chill. The patient was employed in a poultry house handling chickens and rabbits, but stated that he had used gloves constantly for protection.

On the day of admission the patient's temperature was 105° F., pulse 160, and respirations 40 per minute. He appeared acutely ill and cyanotic. No lymph nodes were palpable in the axillary or inguinal regions. There were physical signs of consolidation in the chest. The white blood count on the day of admission was 11,500, and the differential count showed a shift to the left. Sputum was examined and no pneumococci were found. Blood agglutination with *B. tularense* was 1:160; blood cultures were negative.

A roentgenogram of the chest taken on the day of admission revealed areas of consolidation in the upper portion of the left lung and the lower portion of the middle third of the left lung. Roentgenograms one week later showed little change, if any, in these areas of consolidation. The blood ag-

glutination titer with *B. tularense* on that same day was 1:2,560; repeated blood cultures were negative. Ten days later roentgenograms revealed regression of the consolidated areas.

While the patient stayed in the hospital he had a stormy course. Eventually, however, he recovered.

CASE VII: J. W., a 50-year-old white male, entered City Hospital Nov. 21, 1938, complaining of chills, fever, headache, and weakness for nine days. Two days after the onset of his illness a cough developed and three days later he began expectorating "prune-juice" sputum. At this time, he complained of pain in the left chest and epigastrium. One and two weeks before the onset of his illness he had contact with wild rabbits.

The patient was cyanotic and dyspneic, with a temperature of 102.8° F., pulse 116, and respirations 36 per minute.

A roentgenogram of the chest taken on admission showed haziness over the entire right side with an area of consolidation in the base of the right lung. There was evidence suggestive of cavity formation on the right side, due perhaps to beginning abscess formation. The left lung appeared clear and free from involvement. Numerous small clusters of calcification were scattered throughout both lungs and hilar regions. Blood agglutination with *B. tularense* rose from 1:80 on Nov. 24 to 1:640 on Nov. 26. The patient was given supportive treatment and antitularemic serum. He did not respond to the treatment and continued to run a septic course. He was irrational most of the time. Death occurred Nov. 27.

At necropsy the right middle and lower lobes were found to be consolidated in their entirety. The pleural surfaces were dry and firm. These lobes cut with ease and the upper portion of the middle lobe contained a cavity measuring 1 × 2 cm. Its walls were ragged and dirty and it contained a moderate amount of necrotic material. The right upper lobe was subcrepitant, wet, and soggy. Cut sections exuded a reddish frothy fluid. The tracheobronchial lymph nodes were enlarged and some of them were calcified. Microscopic examination showed the pleura to be somewhat thickened and infiltrated with polymorphonuclear leukocytes and lymphocytes. Most of the alveoli were filled with white blood cells consisting of polymorphonuclear leukocytes, large and small lymphocytes, and many plasma cells. Numerous large and small abscesses were present. The blood vessels were engorged. The liver was enlarged (2,560 gm.) and had a typical nutmeg appearance. Microscopically it showed numerous areas of focal necrosis with a heavy infiltration of lymphocytes. The spleen was also enlarged, weighing 500 gm., with a moderate amount of lymphoid hyperplasia demonstrable microscopically.

CASE VIII: O. B., a 36-year-old white male, was admitted to City Hospital Dec. 1, 1940, complaining of chills and fever for five days. About ten days before the onset of his illness, he had cleaned and dressed a rabbit. Seven days later, a pharyngitis developed, which persisted for four days. This was followed by severe chills, fever, headache, nausea, and vomiting. The chills became progressively worse and on the day of admission the patient had a productive cough and pain in the right chest. The temperature was 105.8° F., pulse 100, respirations 32 per minute. The white blood cell count on admission was 16,000 and blood agglutination tests with *B. tularense* were negative.

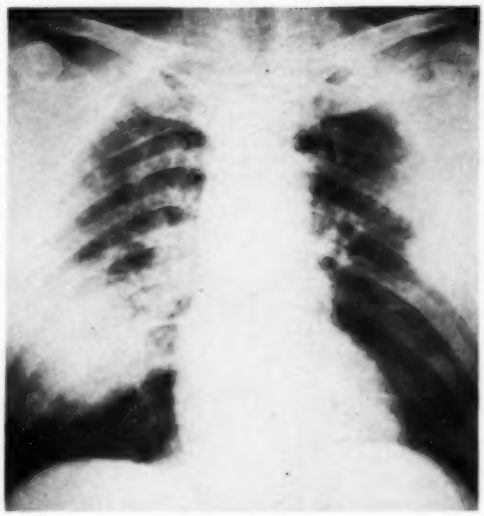

Fig. 5. Case IX (L. T.): Roentgen examination on day of admission reveals dense consolidation occupying the central portion of the right lung field, indicative of an acute pneumonic process.

Roentgen examination of the chest at this time revealed heavy hilar shadows with calcified infiltration and an increase in the lung markings extending down into the right base. There was no evidence of consolidation or pleural effusion. Reexamination twenty-four hours later showed an increase in the lung markings in the right base, suggestive of an early pneumonic process. The disease continued to run a septic course and supportive treatment was given, including one transfusion of citrated blood (250 c.c.). Six days after admission the blood agglutination with *B. tularense* was 1:160 and roentgen examination at this time showed a haziness over the right base, probably due to a pneumonic process.

The patient died the following day, and necropsy showed about 250 c.c. of a light brown fluid in the right pleural cavity. The pleural surfaces of the right lung were roughened by the deposition of small gray areas of fibrin. The lower lobe of the right lung was firm and consolidated. On its surface

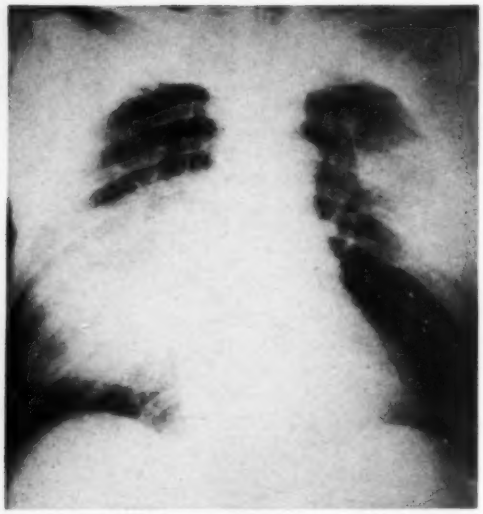

Fig. 6. Case IX (L. T.): Re-examination six days after admission reveals consolidation on the right *increased* in size, with extension of the process into the outer portion of the left upper lobe.

also was a quadrangular area gray in color. Section through this area showed it to be of a peculiar light yellowish-gray hue, with occasional light yellowish-gray foci throughout its margin, while the rest of the parenchyma of the lobe was dark and hemorrhagic in appearance. Microscopic examination revealed a uniform consolidation in all the alveoli. There were patchy scattered foci of necrosis and the alveolar walls were indistinguishable. The nuclei of the cells were pyknotic and necrotic. Polymorphonuclear leukocytes and fibrin were seen in the alveoli. Some monocytes and plasma cells were seen in the exudate. The liver and spleen were moderately enlarged and in both small areas of necrosis were scattered throughout the parenchyma. Microscopic examination of these necrotic areas showed polymorphonuclear leukocytes, plasma cells, and monocytes.

CASE IX: L. T., a 50-year-old white male, entered City Hospital Dec. 15, 1938, in an irrational state. Eleven days earlier he began having chills and fever accompanied by cough and expectoration. Three days before admission he became delirious and grew progressively worse. He had been employed as a meat cutter for several years and three weeks before his illness had dressed rabbits on several occasions.

On physical examination the patient appeared asthenic, poorly nourished, cyanotic, and acutely ill. His temperature was 103.2°, pulse 110, and respirations 30 per minute. The white blood count taken on admission was 10,400 and agglutination with *B. tularense* was 1:320.

Roentgen examination of the chest revealed a dense homogeneous shadow occupying the central portion of the right lung field, indicative of an acute pneumonic process. There was also a moderate increase in peribronchial markings bilaterally. Antitularemic serum and general supportive treatment was given, including daily small blood transfusions of 250 c.c., but the patient did not improve.

Roentgen examination of the chest six days after admission to the hospital showed the area of consolidation still present in the right middle lobe and another area of consolidation in the outer portion of the middle third of the left lung field. At this time the blood agglutination with *B. tularense* rose to 1:1,280. Death occurred five days later.

Necropsy revealed consolidation of the right lower lobe and lower portion of the left upper lobe. On section, the right lower lobe was firm and contained no air, while the consolidated area in the left upper lobe was irregularly shaped, whitish in appearance, resembling an infarct. Microscopic examination showed the alveoli to be filled with fibrin, polymorphonuclear leukocytes, lymphocytes, and plasma cells.

From a study and correlation of the roentgenographic and clinical observations in this series of cases, we believe that there are two basic types of pleuropulmonary involvement in tularemia. One manifests itself by hilar adenopathy in the earlier stages of the disease, with subsequent retrograde extension through the lymphatic channels into the parenchyma of the lung or even into the pleura with production of effusion. We observed this predominantly in the ulcero-glandular, glandular, and oculo-glandular types of tularemia. The other type involves the lung parenchyma primarily, and is usually not preceded by hilar adenopathy. The consolidations are large and homogeneous and roentgenographically resemble pneumonia. This type was found predominantly in the typhoidal type of tularemia.

There is a striking similarity clinically and pathologically between tularemia and bubonic plague (5). The glandular type of bubonic plague is by far the more common form of that disease (6), as is true also of tularemia. The pneumonic form is less common; toxicity is very severe and mortality extremely high, as is true of the typhoidal type of tularemia, which in the greater percentage of cases is complicated by pleuropulmonary involvement.

Pathologically, both of these diseases are manifested by severe necrosis and an inflammatory reaction which is not concomitant with the extent of necrosis (6, 7). It is possible that the two diseases may bear a close resemblance roentgenographically, although we were unable to find in the literature any roentgenographic comparison of bubonic plague.

Grateful acknowledgment is extended to Dr. L. R. Sante for his encouragement and assistance in preparing this paper.

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Roentgenographic Diagnosis of Neoplasms of the Peri-Ampullary Region and Head of the Pancreas[1]

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RADICAL EXCISION of carcinoma of the ampulla of Vater and of the head of the pancreas, together with the entire duodenum, is feasible (Diagram 1). For this reason there should be increased interest in the radiographic diagnosis of neoplasms in these regions. Peri-ampullar lesions should be more readily detected than carcinomas in the head of the pancreas, since the latter, especially in the operable stage, may not produce changes in the duodenal wall or contour of the duodenal curvature.

The term "ampullar carcinoma" is commonly employed to designate neoplasms of the true ampulla as well as those arising from the papilla of Vater or immediate vicinity. Ampullar carcinomas may be polypoid and protrude into the duodenal lumen. When large, they are readily observed. Such an example is shown in Figure 1. This carcinoma was resected transduodenally, with reimplantation of bile and pancreatic ducts and the patient remains well five years later, a roentgeno-

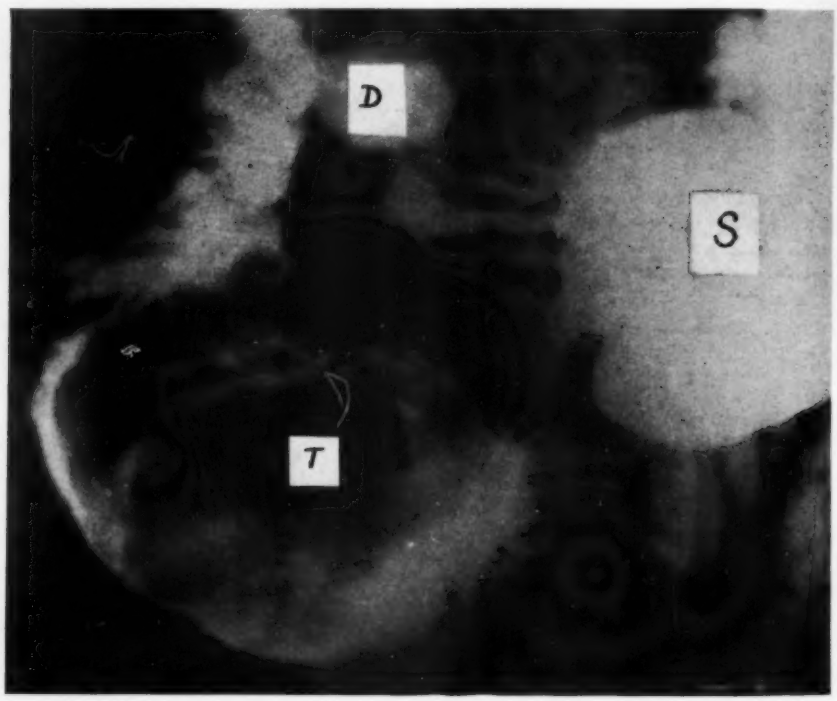

Fig. 1. Barium fluoroscopy showing: *T*, large polypoid neoplasm (carcinoma) arising from papilla of Vater; *D*, duodenal bulb; *S*, stomach. Courtesy American Journal of Surgery.

[1] From the Department of Surgery and the Division of Roentgenology of the Department of Medicine, University of Chicago Clinics. Presented before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

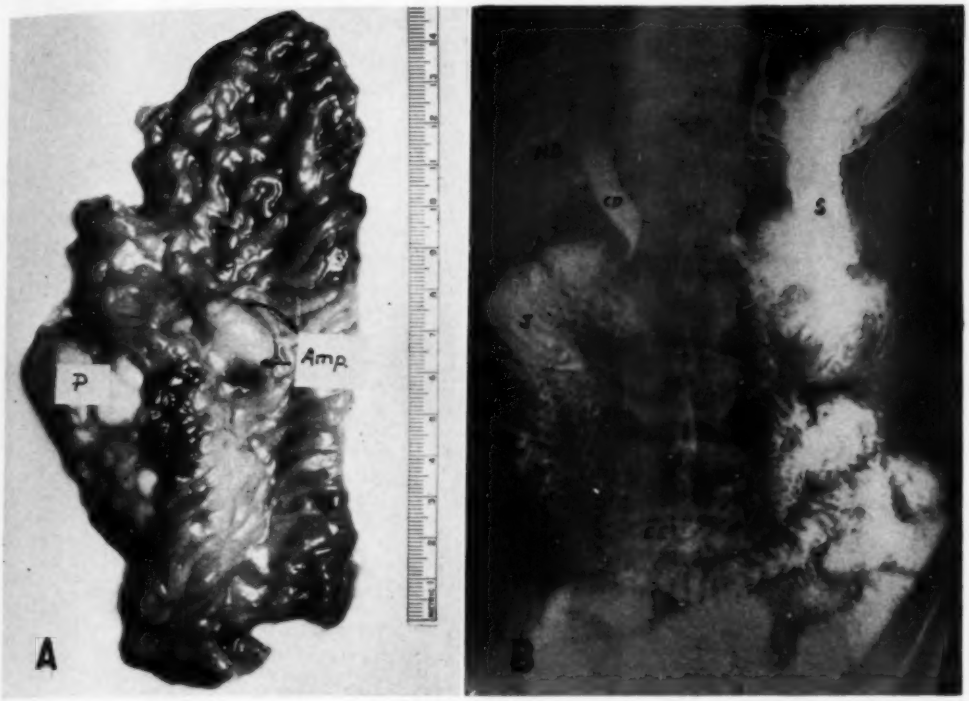

Fig. 2. A. Resected duodenum and head of pancreas (*P*) from a case of ampullar carcinoma that extended upward into the common bile duct for a distance of 2 cm. *Amp*. Enlarged papilla of Vater containing ampullar carcinoma.

B. Barium fluoroscopy three months after one-stage pancreatoduodenectomy for the lesion shown in A. *S*. Stomach. *J*. Loop of jejunum brought up for anastomosis to common bile duct (*CD*). *EE*. Site of entero-enterostomy. *HD*. Large intrahepatic bile ducts, containing barium. The entire head of the pancreas and the duodenum were excised. Patient well and at work five months after operation; regained weight lost.

gram now affording practically a normal picture of the duodenum.

A neoplasm arising within the ampulla expands the latter, affording the appearance of a smooth enlarged papilla of Vater. Theoretically this should be easily demonstrable but inability to produce marked distention of the duodenum by barium probably accounts for frequent failure of detection at fluoroscopy. The surgical specimen shown in Figure 2, consisting of the entire duodenum and the head of the pancreas, resected for ampullar carcinoma extending up the common duct, shows an enlarged and prominent papilla which was not discovered on fluoroscopy. A roentgenogram made three months after operation, as depicted in Diagram 1, shows the disposition of barium in the altered upper alimentary tract (Fig. 2B).

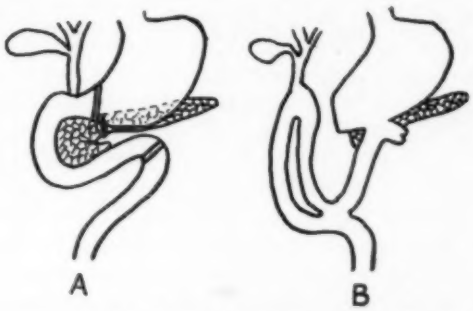

Diagram 1. Schematic representation of one-stage pancreatoduodenectomy, excision of entire duodenum and head of pancreas, for carcinoma of head of pancreas or ampulla. A. Showing lines of transection through lower portion of stomach, neck of pancreas, and at duodenojejunal junction or slightly beyond. B. Restitution of continuity by gastrojejunostomy, choledochojejunostomy (or cholecystojejunostomy), and entero-enterostomy, to facilitate passage of material down the bowel without passing by biliary-alimentary tract anastomosis.

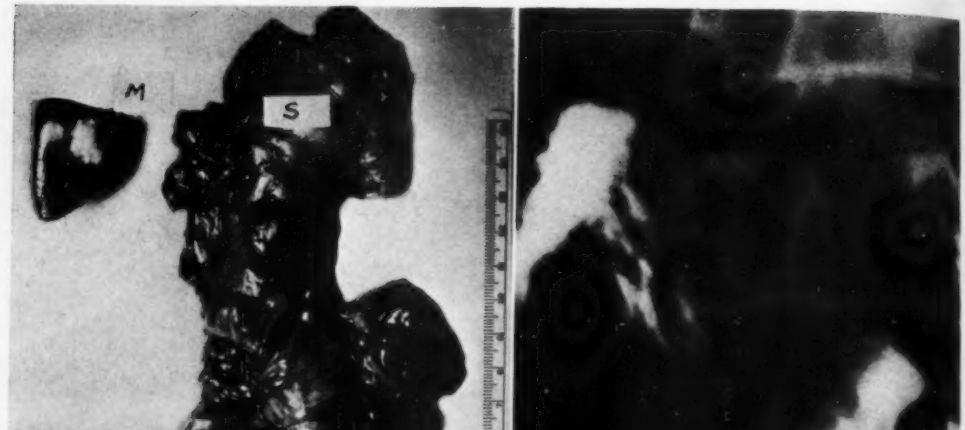

Fig. 3. A. Resected duodenum, head of pancreas, and lower portion of stomach (*S*) from case of oval ulcerating carcinoma (*C*) replacing papilla of Vater. *N*. Metastatic node resected from porta hepatis. *M*. Solitary visible metastasis in liver, also resected. Patient progressed satisfactorily after operation but died on twelfth postoperative day of uremia. Necropsy revealed no hemorrhage or peritonitis.

B. Roentgenogram of duodenum depicted in A, showing deformity (*C*) and rigidity of convex margin of second portion of duodenum produced by flat ulcerating ampullar carcinoma.

Ampullar carcinomas may also afford flattened ulcerations with raised rolled edges (Fig. 3A). These may produce consistent irregularities in outline of the duodenal wall accentuated by a stiffness of the involved segment (Fig. 3B).

Extensive infiltration of the duodenal wall by ampullar carcinoma, or carcinoma primary in the second portion of the duodenum, causes great distortion of the wall and rigidity of the involved segment, and should be easily detected. In these cases, also, normal mucosal markings are replaced by irregular coarse markings and there may be polypoid masses protruding into the lumen. Even in the presence of such evidence of advanced carcinoma resection may well be possible.

Frostberg's "reversed 3" (Ɛ) sign is indicative of edema of the papilla secondary to a neoplasm in the vicinity or to a neoplasm actually within the ampulla. When present it is of great significance, but its absence does not signify that a neoplasm can be ruled out. Figure 4A illustrates this sign in a graphic manner. Some months previously, in another institution, this patient had had a cholecystostomy, which drained persistently. Following admission to the University of Chicago Clinics, injection of iodized oil into the cholecystostomy in conjunction with barium fluoroscopy of the duodenum afforded the picture reproduced here. After transduodenal resection and reimplantation of the ducts, with cholecystogastrostomy, the patient has remained well three and one-half years. It should be pointed out that prominent folds in the duodenum seen in profile may be confused with a "reverse

3" sign. In a true "reverse 3 sign," however, the "lips" are broader than would be true of prominent folds and, furthermore, constancy in the location of the deformity in the presence of peristalsis and palpation is the outstanding and important feature.

Again, all of the criteria for ampullar carcinoma may be present and yet no neoplasm be found, as occurred in the case illustrated in Figure 5. The patient gave a history of painless jaundice for six weeks and it was thought that a distended gallbladder was palpated. Roentgenograms showed an atypical "reversed 3" sign—atypical in that it did not protrude into the lumen. Compression of the second portion of the duodenum produced a rounded indentation, in the center of which was a fleck of barium. This was interpreted as an enlarged papilla with dilated ampulla, the latter receiving the barium. Operation revealed a cirrhotic liver, and an abnormal protuberance downward from the right lobe was found to be the structure palpated before operation and thought to be the gallbladder. Actually the gallbladder was not distended.

As mentioned above, carcinoma of the head of the pancreas is now also amenable to radical resection. However, small tumors within the head of the pancreas usually will not afford evidence of duodenal distortion. Indeed, such small operable carcinomas should not be expected to yield roentgenographic signs of their presence.

Small carcinomas arising in the periphery of the head of the pancreas may invade the duodenal wall and produce areas of rigidity or actual ulcerations which may be accompanied by stenosis and obstruction of the duodenum. In one such patient operated upon by one of us (A. B.) the clinical picture was that of a pyloric obstruction with severe gastric dilatation resulting from invasion and stenosis of the first part of the duodenum by a small carcinoma in the upper portion of the head of the pancreas. A large carcinoma replacing the head of the pancreas may show a minimum of distortion in the duodenum or may produce no alteration in the duodenal contour. The surgical specimen shown in Figure 6, consisting of the lower pylorus, entire duodenum, 3 cm. of jejunum, and the head, neck, and a portion of the body

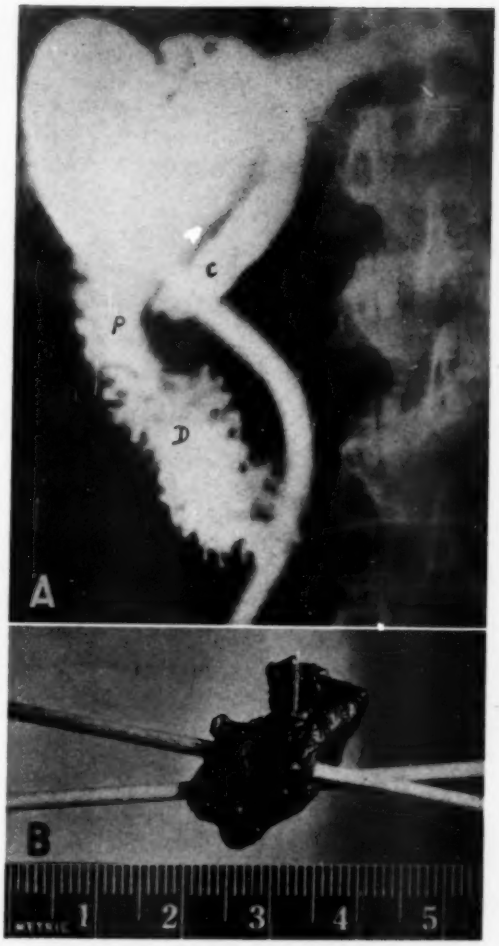

Fig. 4. A. "Reverse-3" sign in patient who had previous cholecystostomy; tube in cholecystostomy for injection of iodized oil. *C.* Common duct, showing arrest of injected oil by neoplasm in ampulla. *D.* Duodenum filled with barium. *P.* Protruding deformity (with reverse-3 contour) in duodenum, due to edematous papilla of Vater containing an ampullar carcinoma.

B. Resected papilla of Vater, shown roentgenographically in A, containing ampullar carcinoma protruding into duodenal lumen above patent bile and pancreatic ducts, into which wooden probes have been inserted. The resected lesion does not appear as large as it did *in vivo* because there was considerable edema. Small lesions such as this are treated by transduodenal resection and reimplantation of bile ducts and pancreatic ducts.

of the pancreas with carcinoma was excised from a patient in whom roentgenologic evidence of cancer of the head of the pancreas was not detectable. Marked widening of the duodenal curve, when present, ordinarily indicates an advanced neoplasm of the head of the pancreas. It is the opinion of the writers, however, that regardless of roentgenographic evidence of extensive neoplasm, exploratory operation should be performed.

It thus appears that roentgenographic examination may afford clear-cut evidence of the presence of an ampullar carcinoma or carcinoma of the head of the pancreas. On the other hand, such lesions may be of appreciable size, still operable, and yet afford no roentgen evidence of their pres-

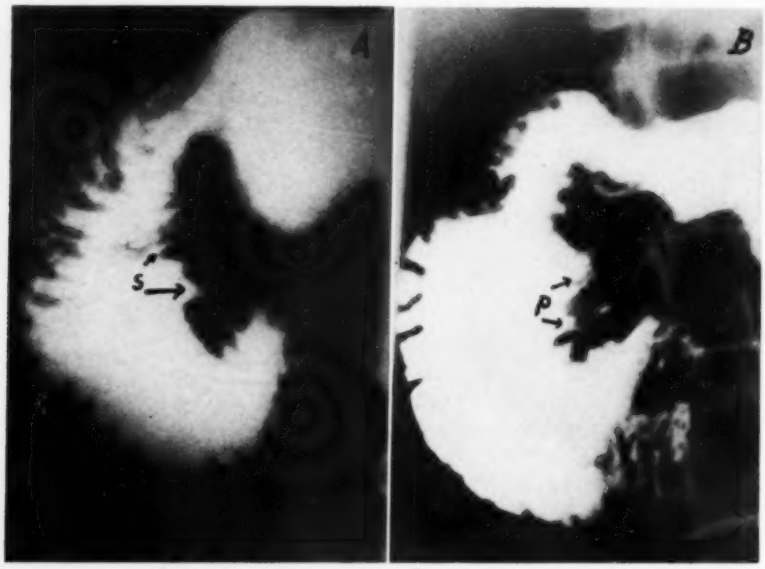

Fig. 5. A. Barium fluoroscopy of duodenum in patient with icterus and with what was thought to be a palpable gallbladder. *S.* "Atypical" reverse-3 sign. While the reverse-3 configuration is present, it appears to be a diverticulum rather than an indentation into the lumen.

B. Compression of the duodenum afforded the impression of an enlarged papilla of Vater (*P*) with barium entering the ampulla. At operation, no neoplasm was found, and icterus proved the result of diffuse cholangeitis. The papilla of Vater was normal on direct visualization.

Fig. 6. Resected head and neck of pancreas, *P;* lower portion of stomach, *S;* and entire duodenum. The carcinoma caused enlargement of the head of the pancreas but was not detected at fluoroscopy.

ence. In the diagnosis of such lesions the clinical picture of obstructive icterus, unassociated with typical gallstone colic, possibly accompanied by an enlarged, distended and palpable gallbladder (Courvoisier's sign) is the most important indication for exploratory laparotomy. Persistent epigastric pain or upper abdominal pain, often deep boring in character and radiating through the body to the back, is suggestive of carcinoma of the head of the pancreas, whereas, obstructive jaundice accompanied by some pain at the onset and later "painless" is more indicative of ampullar carcinoma. Exploratory laparotomy should not be postponed because of lack of roentgenologic evidence of neoplasm in the ampulla or in the head of the pancreas. Nor should it be refused because of roentgen evidence of extensive duodenal involvement, since resection of even large tumors in this region may afford some degree of palliation for those patients whose average length of life in the absence of treatment is but six to eight months from the onset of symptoms.

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Non-Organic Gastric Filling Defects Simulating Carcinoma[1]

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THE MAJORITY of benign and malignant gastric tumors are located in the pars pylorica of the stomach and reveal their presence roentgenologically as prepyloric deformities. Gastric spasm and extragastric lesions may produce such deformities. The differential diagnostic features of these defects have frequently been described. In a recent paper on gastric cancer, B. R. Kirklin (4) summarized the roentgenological findings usually considered as the pathognomonic syndrome of advanced mucoid carcinoma: a gross filling defect projecting from a wide base far into the gastric lumen; an irregular internal margin; sharp demarcation from the uninvolved portion; and, as a rule, little or no alteration in the size of the stomach. These features may be associated with physical signs and secondary manifestations, namely, a palpable mass; fixation of the stomach; destruction, effacement, or smoothing of the gastric rugae; absence of peristalsis from the affected portion, and rapid emptying time unless obstruction is present.

Kirklin includes gastrospasm and various extrinsic conditions among lesions to be differentiated from carcinoma and states that the deformity produced by carcinoma is persistent as to site and configuration, withstands manipulation, and remains unchanged at subsequent examinations, while distortions caused by simulants have none of these qualities.

We are presenting the history, the roentgenologic, operative, and pathologic findings in two patients in whom a diagnosis of gastric carcinoma was made, based on most of the diagnostic features listed above. In both instances our diagnosis was incorrect.

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

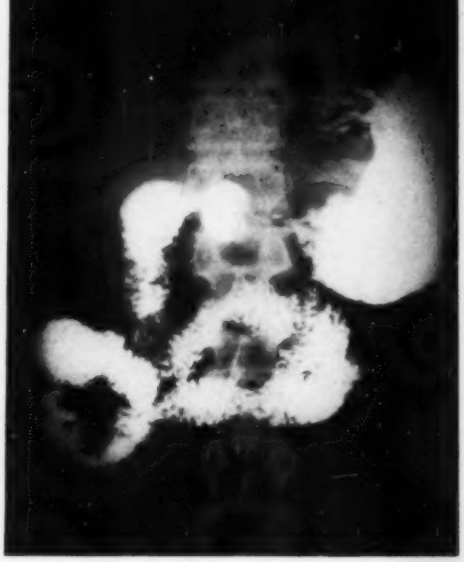

Fig. 1. Case 1: Film showing filling defect, with involvement of rugae, after administration of atropine (Jan. 2, 1942). Note the similarity to Figure 2

CASE 1: R. C., a male, age 51, was admitted to St. Luke's Hospital, Dec. 29, 1941. He complained of pain, varying from dull to intense, in the upper abdomen, epigastric distress following meals, occasional vomiting, and failure to get the relief alkaline powders had previously given him. His first gastric symptoms dated back one year, at which time he first experienced epigastric discomfort, bloating, and belching. Except for recurrences of similar dyspepsia within six months and again a few days prior to his admission, he had felt quite well, showing no lassitude, loss of weight, or weakness. Five days prior to admission, Dr. James T. Case had made a complete roentgenologic study of the patient's gastro-intestinal tract. A diagnosis of organic lesion of the pylorus was made, the exact nature of which was not stated. The lesion was thought, however, to be due to an inflammatory process.

Physical examination was negative except for a mild dyspnea. Laboratory findings of note were as follows: hemoglobin 15.1 gm.; R.B.C. 5,090,000; gastric contents, free HCl 56°, total acid 68°; two blood Kahn tests negative. Five stool examina-

tions were negative for blood and amoebae. Total N.P.N., blood sugar, blood calcium, and cholesterol were within normal limits. The sedimentation rate was within normal limits. A chest film and Graham-Cole study of the gallbladder showed no abnormalities. The electrocardiograph showed nothing of importance.

On Jan. 2, 1942, we made a careful roentgenologic examination of the gastro-intestinal tract. The patient was given 1/100 grain of atropine sulfate by mouth, twenty-four, twelve, and two hours prior to the examination. Eight minims of tincture of belladonna were administered six hours before examination. The stomach showed a large, well circumscribed filling defect involving the walls of the pars pylorica. There was no large intraluminal mass. The lines of demarcation were rather sharp and the rugae irregular. In the pars cardiaca and pars media the rugae appeared distorted and thickened. Fluoroscopically, the pyloric defect was constant, and the peristaltic waves did not traverse the area. Comparison of our films (Fig. 1) with those of Dr. Case (Fig. 2) leaves no doubt as to the constancy of the lesion. The duodenal bulb was normal. The roentgen diagnosis was "filling defect involving the pars pylorica, which should be considered malignant until proved otherwise." Gastroscopic examination offered no additional information, as the pylorus could not be seen satisfactorily. The body of the stomach was smooth and the mucosa normal. Projections beyond the angularis on the lesser curvature were thought to be thickened folds.

At operation the stomach and duodenum appeared externally normal. Nothing was found in the nature of indurations, nodules, or glands in the stomach. The gallbladder, liver, and surrounding regions were normal to inspection and palpation. In view of the roentgen findings, an incision was made one inch above the pylorus on the anterior wall of the stomach. A small section of mucosa, muscularis, and serosa, was removed for gross and microscopic study. The lining of the stomach and first part of the duodenum were inspected, palpated, and found normal. Microscopic examination of the biopsy specimen showed normal gastric tissue and no evidence of disease (Dr. E. F. Hirsch).

Dr. S. W. McArthur's observations during the operative procedure are extremely interesting in view of the roentgen findings. Palpation of the pylorus and antrum gave him a definite impression of induration in the entire region. After a short pause, with the region still between the thumb and index finger, this impression vanished entirely.

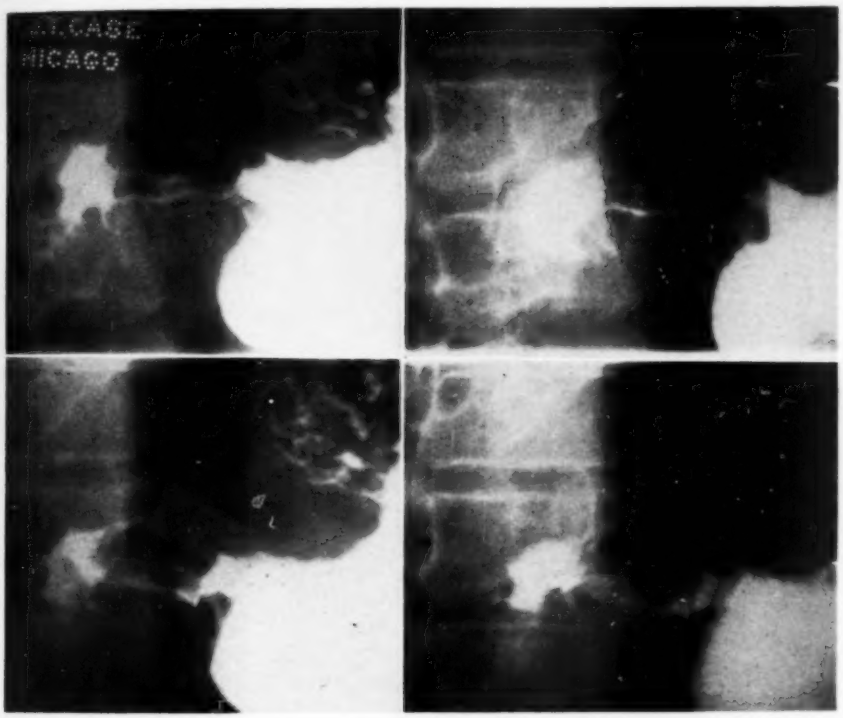

Fig. 2. Case 1: Original film (Doctor Case), showing filling defect in pyloric antrum and involvement of rugae.

On further palpation and visual inspection, he observed an extraordinary spasm involving the stomach when first touched, followed by relaxation, with normal consistency to palpation. During the entire operative procedure any traction on the stomach or palpation of the splenic area produced a profound regional gastrospasm with prompt cessation of respiration.

In view of the profound gastric spasm exhibited by this patient under general anesthesia, it is reasonable to suppose that the antispasmodics given prior to the second roentgen examination had little or no effect.

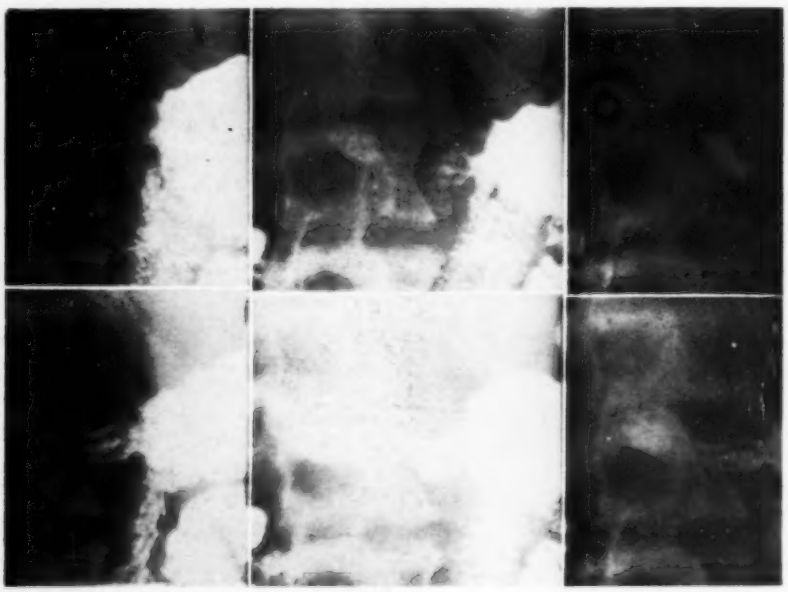

Fig. 3. Case 2: Film showing filling defect and distortion and partial destruction of the rugae (Aug. 5, 1940). These findings were constant during fluoroscopic examination.

Objections have been raised to the use of atropine and belladonna as antispasmodics. Ritvo (5) found atropine ineffective in gastrospasm and recommended 20 to 30 mg. of benzedrine sulfate orally in suspected gastrospasm and pylorospasm. Cerqua (2) showed that large doses of atropine in dogs produced spasm of both the pylorus and fundus. On the other hand, more frequent use of atropine and belladonna has been advised in a recent paper by Bernard and Monnier (1). They regard it as an aid in differentiating spasm from ulcer, perigastritis, neoplasms, and parietal lesions. Stone and Ruggles (6) believe it advisable to administer atropine or belladonna until the throat is dry in order to relax gastrospasm and pylorospasm.

Amyl nitrite was tried by us but was discontinued due to the frequent fainting of the patients at the time of examination. Mecholyl, physostigmine, and calcium gluconate have also been tried, but are not advised for routine use. The antispasmodic action of drugs is a result of their effect upon the extrinsic nerve supply of the stomach which supplies the outer longitudinal and inner circular muscular layers. Vagus stimulation activates the stomach, whereas sympathetic stimulation relaxes it. According to the theory advanced by Forssell (3), the gastric mucosa can adapt its rugae, in response to the stimulus of food, as a local autonomic response, not dependent upon the distant nerve control. Gastrospasm is usually thought of as intrinsic, due to gastric pathology, or extragastric, due to reflex or other stimulation of the extrinsic nerves.

Since no pathological condition could be demonstrated in our case, we feel that the changes were due to local autonomic response.

A similar case, presenting the possibility of muscular mucosal spasm was examined by us in 1940.

CASE 2: E. H., a male, age 48, complained of distress and bloating after eating. His appetite was poor, but eating, lying down, or belching relieved the distress for a short time. He often experienced faintness and nausea, but there was no history of vomiting. The bowel movements were regular and the stools normal. The history was negative except for the fact that the patient had been working very hard (fourteen to fifteen hours a day). The physical examination was negative. The laboratory findings were as follows: hemoglobin 90 per cent (Sahli); R.B.C. 5,360,000; W.B.C., differential count, and sedimentation rate normal. The urinalysis, Wassermann, and Kahn tests were negative. There were no other significant findings.

Roentgen examination of the stomach by means of a barium meal on Aug. 5, 1940 (Fig. 3) revealed a definite narrowing of the pyloric antrum for a distance of 3 cm. The rugae appeared distorted and partially destroyed. The filling defect was constant during the fluoroscopic and serialographic examinations. The stomach was hyperactive, but the filling defect was clearly demarcated. The pylorus was spastic and allowed no barium to pass through for about fifteen minutes. Re-examination was advised after administration of an antispasmodic and was done two days later after atropinization to physiological limits. The pyloric antrum was again found narrowed and spastic. In some of the films the rugae appeared normal, and the possibility of a hypertrophic pylorus with spasm was considered. Re-examination was again advised after medical management. Approximately one month later, on Sept. 10, 1940, the stomach was re-examined with a barium meal. The pyloric antrum was again narrowed (Fig. 4) as before. The peristaltic waves extended downward to the pars pylorica, then ended abruptly. The roentgen diagnosis was "organic filling defect, probably malignant, but hypertrophy of the rugae and pyloric muscle must be considered."

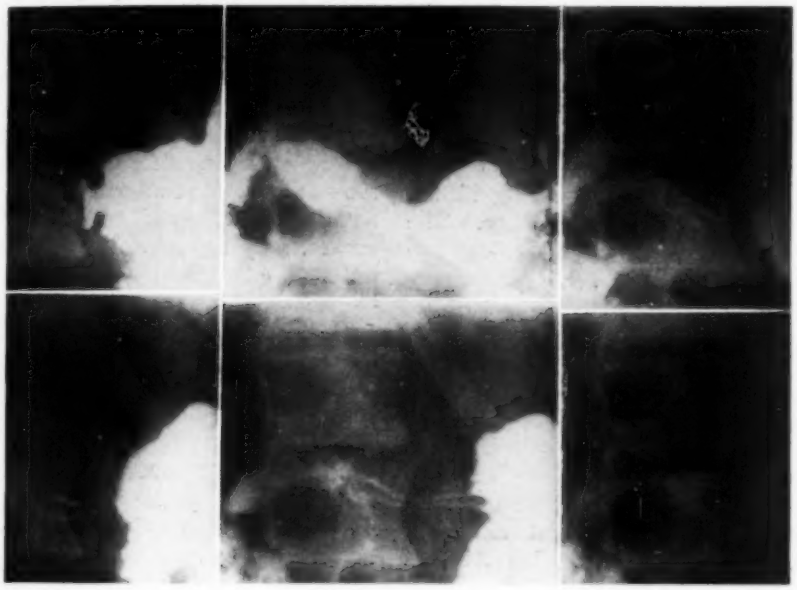

Fig. 4. Case 2: Persistence of filling defect after medical management and administration of antispasmodics (Sept. 10, 1940).

At operation it was Dr. G. V. Pontius' impression that the pylorus was thickened. The stomach was opened and the mucosa revealed hypertrophic rugae, but no definite mass could be distinguished. There was no evidence of enlarged lymph nodes. A partial resection was decided upon and the distal fourth of the stomach was removed. A gastrojejunal anastomosis was done. The pathological report was as follows: "No rugae or pyloric hypertrophy could be seen in the resected portion of the stomach and duodenum. Microscopically, serial sections of the

entire resected portion revealed no invasive epithelial growth or inflammatory process" (Dr. E. F. Hirsch).

As in the first case, the surgeon may have felt and seen a gastric spasm which he interpreted as pyloric and rugal hypertrophy. On the basis of Forssell's work (3), such a spasm may be postulated as involving the muscularis mucosa. Atropine would not be expected to relieve such a spasm. On Jan. 29, 1942, approximately one year after the gastric resection, we again examined E. H. The stoma at the site of the anastomosis seemed to function perfectly. The remaining portion of the stomach was found to be normal, except for prominent gastric rugae.

We have recently examined several patients fluoroscopically immediately after intravenous administration of 1/75 gr. of atropine. The changes occurring in the stomach are prompt and definite. The peristaltic waves, active prior to the administration of the drug, are absent a very few minutes thereafter. The stomach becomes relaxed and appears flaccid. There is a pronounced increase in the cardiac rate immediately following the administration of the drug. There have been no untoward reactions in the few cases we have observed. The intravenous administration of atropine may, in selected cases, be more efficacious than the oral or intramuscular method. It is impossible, however, at this time to state categorically whether this procedure is useful and safe.

The intravenous administration of atropine for the control of spasticity is by no means new. Dr. James T. Case did a considerable amount of work with atropine intravenously a number of years ago. Very little on the subject is found, however, in the literature.

COMMENTS

The lesions described in this paper were not of the medullary type. We were unable to identify an intraluminal mass in either case. The changes appeared to be quite superficial, and only the walls of the stomach seemed to be involved. Both curvatures of the pyloric antrum were irregular and the area was sharply demarcated. Peristaltic waves were absent in the affected area. Palpation gave one the impression of rigidity with loss of pliability. The contracted antrum could not be expanded by palpation, even when using force. Although a negative pathological report was rendered in these two cases, we are of the opinion that careful re-examination should be made at rather frequent intervals.

At present we must accept the pathologist's report. Perhaps in time the apparent spasm may prove to be an early manifestation of something more serious, which will shortly become evident. It is not unusual to encounter spasm as the first symptom in carcinoma of the esophagus.

The gastric manifestations, both fluoroscopically and roentgenographically, are not those of a normal stomach. Spasm, of course, may be due to an overstimulated autonomic nervous system. The deformity caused by spasm is usually smooth. Vitamin deficiency also has been given as a cause for spasm.

The lowered vitality of the tissues may serve as a fertile ground for the development of an infection or an inflammatory process. This hypothesis, however, is not substantiated by the pathological report, as there was no evidence of an inflammatory process.

SUMMARY

1. It is our opinion that large constant deformities of the pars pylorica may be due to spasm not associated with organic disease. Atropine and belladonna had no effect in relaxing the spasm in the cases presented.

2. The presence of a constant gastric deformity does not always mean carcinoma, nor does it preclude the possibility of spasm as the cause of the deformity.

3. Filling defects due to intraluminal tumors are not difficult to differentiate. Deformities involving only the walls of the stomach, even though present at several examinations and resistant to antispasmodics, may be due to spasm.

4. The old concept that spasm of the pyloric antrum appears smooth and narrow fluoroscopically and roentgenographically is not borne out by the facts presented in the reported cases.

5. Further investigation is necessary regarding antispasmodics. A drug which could be depended upon to relax the stomach at all times would be of immense aid in differentiating gastric lesions.

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DISCUSSION

James T. Case, M.D. (Chicago, Ill.): I wish to pay my respects to the authors for their courage in reporting cases of this sort. I am sure all of us have experienced the chagrin of having our opinions contradicted by the surgical findings.

I recall one case of this sort in which I reported a lesion exactly similar to the ones described by Doctor Jenkinson, where the gastroscopist failed to see any sign of an organic lesion in the pyloric end of the stomach and my diagnosis of carcinoma was discredited. One year later, however, to the day, the patient returned to the gastroscopist for a further examination, without going through the x-ray department, and this time there was discovered an inoperable carcinoma of the stomach. One must conclude that a stomach with a persisting prepyloric deformity, even though this is thought to be spastic, must be considered a potential host of ulcer or carcinoma.

Another occurrence which may lead to a similar filling defect in the pyloric region is gastrogastric invagination—that is, invagination of the prepyloric end of the stomach, including the duodenum and distal end of the stomach, back into the stomach. This would give the same kind of filling defect as has been reported by a few authors. In my personal work I have had no proved case of gastrogastric invagination, but I believe we should be on the lookout for it and recognize it when we see it.

I am afraid if I had to examine again the patient of mine whose case Dr. Jenkinson reported, with the same findings as before, I would make the same diagnosis—an organic lesion of the stomach.

J. R. Maxfield, Jr., M.D. (Dallas, Texas): Doctor Jenkinson's excellent presentation has been of unusual interest to me, since I have recently had a case that parallels his in many ways.

A colored female came to the X-ray Department with a prepyloric defect similar to those he has described. This defect was constant on three fluoroscopic examinations, in spite of the use of antispasmodics. A gastroscopic examination was done by Doctor Patterson of Dallas and he reported "no organic lesion found." Since the patient had a positive Wassermann reaction, it was assumed that the lesion was syphilitic in origin. Despite adequate antisyphilitic therapy, however, subsequent fluoroscopic examinations showed persistence of the defect. Operation was then decided upon. When gross examination of the stomach revealed no pathological condition and there was nothing palpable, the radiologist was called to the operating table. The possibility of closing the incision without opening the stomach was discussed but at the insistence of the radiologist it was decided that the stomach should be looked into. A small incision was made and on the posterior wall of the stomach was a small mass, 2 to 3 mm. in diameter. It was obviously, however, not the defect reported on fluoroscopic examination. This mass bled when wiped with a suction tip. It was removed for biopsy and the pathological report was papillary adenoma (gastric polyp).

This patient has been examined fluoroscopically several times since operation, and the defect in the stomach is still present. She has gained weight, going from 90 to 130 pounds. She is still on antisyphilitic treatment. The last examination still showed the defect in the lower portion of the stomach, about an inch and a half prepyloric, with the same appearance as at the first examination.

Sherwood Moore, M.D. (St. Louis, Mo.): I would like to ask Doctor Jenkinson about the Wassermann reaction in his patients and whether or not there was a history of syphilis.

Samuel Brown, M.D. (Cincinnati, Ohio): I have been very much interested in Doctor Jenkinson's paper and illustrations. In a number of cases I have encountered similar abnormal shadows which were difficult to differentiate from those produced by true gastric tumors. Re-examination after administration of an antispasmodic often helps to remove any doubt as to the nature of the abnormal shadows.

Frederic E. Templeton, M.D. (Chicago, Ill.): We have seen a number of lesions such as Doctor Jenkinson described. We have followed several of these cases for long periods of time and in all we have at some time or other encountered an ulcer on the vertical portion of the lesser curvature. The narrowed antra which accompanied these ulcers persisted after the ulcers healed. These narrowed antra also complicated the medical treatment of the ulcer by causing considerable retention.

At gastroscopy some of these antra appeared normal. Microscopic study after gastric resection indicated the existence of inflammation in some and abnormal changes in others.

In one of Doctor Jenkinson's slides I thought I could see an ulcer on the lesser curvature about 4 or 5 cm. above the narrowing. Did the long range history suggest ulcer in any of these cases?

Edward L. Jenkinson, M.D. (*closing*): Answering Doctor Moore's question, in both our patients the Wassermann and Kahn reactions were negative. The patients had no history of syphilis.

Regarding Doctor Templeton's discussion, I felt as he did. I thought perhaps the patient might have an ulcer. The symptoms were not very definite, but I pointed out that there was an ulcer, and, further than that, the surgeon removed the area. In the second case, which showed a deformity, the whole pyloric portion of the stomach was resected. The pathologist, of course, is the court of last resort. He did serial sections on both of these cases and found no lesion in either. Irrespective of what the pathologist says, however, these are not normal stomachs. If they are, we had better change our ideas of what a normal stomach looks like.

Possibly I should not have shown these cases at this time. I have been trying to get the first patient back for re-examination, but unfortunately I have not been able to do so. I believe these patients should be examined further. I am not satisfied and feel that there may eventually develop a lesion that can be proved by sections. All I can say now is what we thought. We were apparently wrong, in view of what the pathologist reported.

Observations on Venography of the Lower Extremities[1]

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THE OBSERVATIONS on venography of the lower extremities recorded in this paper have been made from a series of approximately 130 cases and cover a period of a year. Interest in the subject was stimulated by reports of cases of acute thrombophlebitis by Fine and Sears and by Homans and Dougherty, but the work was undertaken without any preconceived ideas obtained from the literature. Bauer's fine monograph was not seen until several months later. Acute thrombophlebitis is not as yet thoroughly investigated in most places. The aid to be obtained from venographic procedures both for diagnosis and as an indication for treatment is not sufficiently appreciated. Many of our cases were investigated because of chronic conditions involving the legs.

Since a number of our observations are dependent upon technical factors, a brief report of the manner in which the work was done will be given. It is our belief that adequate roentgen examination involving physiological processes cannot be made with a single film. Physiological changes in many parts of the body are rapid and somewhat variable. The ideal method for the study of such processes would be by moving pictures if this were technically feasible. Photo-roentgen devices may make such studies possible, but these are still out of the question for most of us.

The next best procedure seems to be a serial method, consisting in multiple film studies made over varying time intervals. The passage of dye through the venous and arterial circulation is rapid. In our own experience, the interpretation of single films is tricky and frequently misleading. Fortunately, in the lower extremity, with the patient supine, the dye passes through the venous circulation slowly enough to be demonstrated in multiple exposures from the region of the ankle to the thigh and including the first portion of the external iliac vein. This will be brought out more fully later.

For our studies we have used diodrast, the patient being given the Dolan mouth test prior to injection. Twenty cubic centimeters of the dye are injected slowly over a period of approximately two minutes through a very small needle into a small vein on the dorsum of the foot or below the internal or external malleolus. In our experience, it has only occasionally been necessary to cut down on a vein for injection of the dye—in cases with such severe edema or swelling of the foot and ankle that it was not possible otherwise to find a vein.

In our first serial method we utilized a device which we already had, which allowed the division of a 14 × 17-inch film for three exposures. This worked fairly well for the small leg and the region of the knee. For the bulky or adipose extremity with varicose veins and for the circulation of the thigh and groin, it was difficult to position the patient so that the full venous circulation could be demonstrated. In recent months, we have been using two lead screens, one on either side of the top of the Bucky table, of sufficient width so that the intervening space allows a coverage of half a 14 × 17-inch film. These lead screens are long enough to reach from the ankle to the lower abdomen. Between them the extremity can be satisfactorily positioned so that the entire venous circulation of the leg, thigh, and lower pelvis can be portrayed on serial films.

During the two minutes of injection, six exposures are made. The first two are made from the region of the ankle upward after about 4 to 5 c.c. of dye has been injected. As soon as the tube stand and Bucky tray can be shifted upward, two

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

more exposures are made of the upper leg and knee and lower thigh. Again, the tube stand and Bucky are shifted upward and the last two exposures are made, including the upper thigh and lower pelvis. These exposures are in pairs and each is made from a stereoscopic position. We realize that any part must be absolutely still for a proper stereoscopic view. The dye remains long enough in one place, however, to allow us to differentiate between the deep and superficial circulation. This has proved to be very important and is one of the difficult problems in a single-film examination. By rapid work, it is possible to complete six exposures while the dye is being injected. Occasionally, a fourth film is made with two exposures, one on either half of the film, after the conclusion of the injection. Usually, this film is made of the upper leg and knee area.

By this procedure, we obtain a series of overlapping films of the region from the ankle up to and including the lower pelvis. The time interval between these films is such that in the normal case visualization of the venous structures of leg and thigh into which the dye enters is obtained. The fourth film gives us added information about the upward passage of the dye in the upper portion of the extremity. The stereoscopic films enable us to reconstruct anatomical positions with considerable certainty.

A review of the anatomy as disclosed in studies of normal and pathological material is in order. For this purpose it seems simpler to describe venous structures in their order from above downward. The uppermost part of the venous tree which is demonstrable is the external iliac vein. Frequently, this can be seen for a distance of several inches before the dye becomes too diluted with blood from other parts of the body so that the contour is lost. In the region of the femoral fossa, immediately below Poupart's ligament, there is normally a large valve where the internal or greater saphenous empties into the femoral vein. This, in our experience, has been very constant. Below the junction of the femoral with the internal saphenous there are frequently several valves, about two inches apart. The femoral vein proceeds downward approximately in the region of the femoral artery. It winds around the inside of the thigh slightly away from the femur and continues down the inner portion of the thigh toward the popliteal fossa. This vein frequently divides into two or three parts. These divisions are more frequently seen in the lower half of its course, but usually recombine before the popliteal fossa is reached.

At the upper portion of the popliteal fossa, the femoral vein, which is here normally seen as one large vein, becomes the popliteal vein. This latter vein is extremely variable. It usually breaks up into two or three main trunks, which follow the divisions of the popliteal artery. It may divide in the upper portion or in the middle of the popliteal fossa or, occasionally, lower down, in the upper leg. The two main divisions usually seen are the anterior and posterior tibial veins. The third division is the peroneal vein. Frequently, this appears to have its origin below the division of the popliteal into the two tibial veins, coming off the posterior tibial. This latter vein may divide into two parts. These three deep veins proceed downward fairly close to the interosseous space between the tibia and fibula, almost to the region of the ankle, before being lost as individual trunks.

Two other main venous trunks, found rather constantly, should be mentioned: the internal and external saphenous veins. The *internal saphenous* or greater saphenous starts at the femoral fossa and proceeds downward in the superficial tissues along the inner portion of the thigh to the region of the knee. Usually, this vein is demonstrable as a main trunk almost to the ankle. Coming off from the internal saphenous in the middle and lower thirds of the thigh are several deep communicating veins which pass inward to the femoral vein. These veins have been seen frequently in normal material and very frequently in pathological conditions. Below

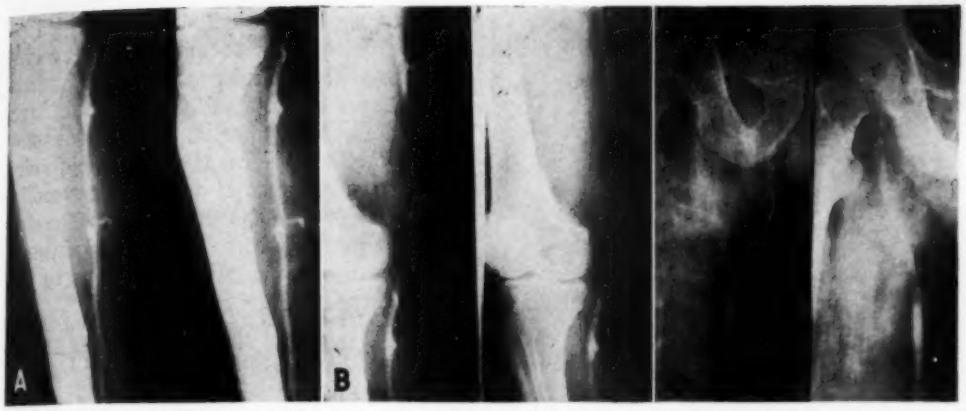

Fig. 1. Block of deep circulation. The three films, representing six exposures, constitute a serial set. The dye goes up through the internal saphenous and on into the iliac in the region of the femoral fossa. In A and B, retrograde extension of the dye can be seen into two veins overlying the lower portion of the femur. This retrograde extension is through valves. These veins are dilated.

the knee the internal saphenous frequently breaks up into many trunks which anastomose freely with the superficial circulation.

The *external saphenous* vein is usually seen as a main trunk from the region of the ankle upward to the knee. It is commonly held that this vein dips inward slightly above the knee and joins the popliteal vein in the upper portion of the popliteal space. We have, however, observed this very few times. In most of our material, both normal and pathological, the external saphenous breaks into a plexus of veins at the knee, or above or below it. This plexus of veins passes posteriorly through the superficial tissues and empties into the internal saphenous either close to the knee or above it.

Occasionally, a connection of the internal saphenous also empties into the popliteal vein. Sometimes, a superficial vein runs directly upward in the posterior part of the leg. On a single anteroposterior film this may be confused with a deep vein. The superficial veins that have been visualized lie largely in the leg and around the knee. They have been seen as a considerable plexus freely communicating with one another and with deep communicating veins lying largely in the internal, posterior, and lateral aspects of the leg. The veins in the anterior portion of the leg have been visualized only in pathological cases. In the region of the ankle and from the ankle upward to the knee, the deep communicating veins connecting with the superficial plexus overlying the inner, posterior, and lateral portions of the leg, are frequent and many. These deep communicating veins are usually rather short. Venae comites or paired veins have rarely been observed. The number of valves has been variable.

By the use of serial films, we believe that observations can be made which can properly be called physiological. In an endeavor to have a base line on which to form our conclusions, a number of normal subjects have been examined in the manner described above. Patients referred for intravenous urography were given the dye in a small vein in the region of the ankle, or below, and studies were made of the venous structures of the leg prior to the making of the urograms. These persons had no history of past or present trouble in the extremities.

From a physiological point of view, the point of injection of the dye makes surprisingly little difference as to the manner in which it traverses the venous structures of the leg. If the injection is made under the external malleolus, slightly more of the dye appears to pass up the external

Fig. 2. Deep block of leg and lower thigh. The dye is passing up through the superficial circulation to the mid portion of the thigh. At this point, most of the dye goes inward through communicating veins and upward through the femoral vein. The deep circulation is blocked in the leg and lower half of the thigh.

venous branches and the external saphenous is more likely to be seen. If a vein on the dorsum of the foot is chosen, the dye spreads in both directions laterally and internally and then goes around into the posterior veins. If the dye is injected over the internal malleolus, more of it tends to pass up over the inner and the posterior surface of the leg. In normal subjects, immediately following injection the bulk of the dye seeks the deep communicating veins in the lower part of the leg and enters the deep circulation fairly close to the ankle. A small percentage spreads through the superficial circulation, and the superficial venous structures up to the knee are usually demonstrable. As a rule, the internal or greater saphenous vein is well shown regardless of the point of injection. The fact should be emphasized that in the normal person, lying supine, most of the dye injected in the region of the ankle appears to enter the deep circulation directly and pass upward through this channel. A smaller amount of dye travels directly upward through anastomosing channels in the superficial circulation. Progress of the dye is steadily upward unless disease is present. The dye in the superficial vessels may swing inward through deep communicating veins to the deeper structures.

The time element involved in the spreading of the dye from one area to another is important both from the standpoint of obtaining satisfactory films and, to some extent, from the standpoint of interpretation. On the basis of numerous serial films taken at varying intervals of time, a few generalizations can be made. Within ten to fifteen seconds after the injection is started, the dye has spread to the superficial veins in the ankle region and has started to enter the deep circulation, usually in the lower third of the leg In the usual case the dye which enters the deep circulation goes upward somewhat more quickly than that which remains in the superficial veins. At approximately thirty to forty-five seconds, the deep veins in the lower leg will normally be well filled and the lower femoral will usually show good filling. Frequently the dye passes up the internal saphenous vein to approximately the same level as seen in the deep veins in thirty to forty-five seconds. In the remainder of the superficial plexuses of the leg the dye usually goes upward somewhat more slowly and a number of the superficial veins of the knee may not be demonstrable for a minute to a minute and a half. Above the knee, progress is rapid through the popliteal and femoral vein. By this time the dye is becoming somewhat diluted, and unless films in this area are made during the injection, visualization is usually incomplete or entirely lacking. The optimum time for taking the film of the upper thigh appears to be, approximately, from forty-five seconds to a minute and a half after the injection is begun and while it is still going on.

In a number of normal subjects we have found the dye to remain in the deep veins and some of the superficial veins of the legs as long as five minutes or slightly longer. This, however, occurs only if the patient has been perfectly still and has not moved during this period of time. Motion of the leg or muscle contraction appears to force the dye upward. This observation gives rise to speculation concerning postoperative thrombosis. Does

Fig. 3. Typical example of deep block of the leg. The dye travels up through the superficial circulation to the region of the knee. There a portion passes inward to the femoral or popliteal and thence upward in the femoral. The other portion of the dye goes upward through the superficial circulation.

the prolonged inactivity of the legs on a relatively hard table, while the patient is anesthetized, cause prolonged stagnation of venous blood? Such slowing of the venous stream combined with a very minor bruise would certainly set the stage for a thrombophlebitis.

In younger persons, with extremely straight veins, the dye passes upward more quickly than in older subjects with slightly tortuous or dilated veins. Normally the dye does not remain in the veins of the

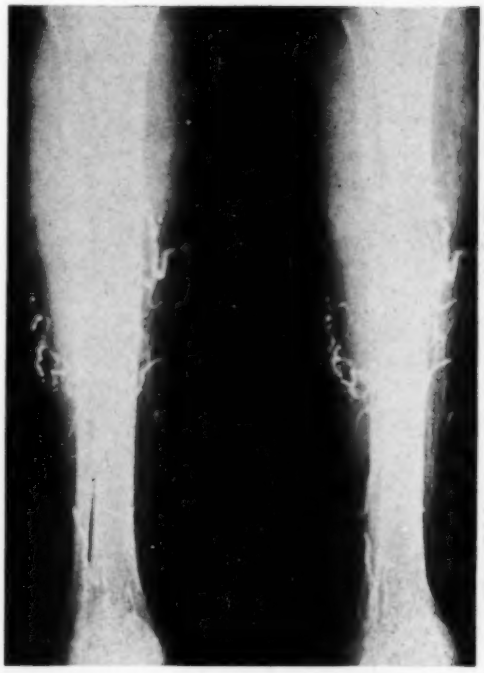

Fig. 4. Superficial block in the upper half of the leg. The dye passes up through the superficial plexus to the mid leg and thence inward to the deep circulation, as it is abruptly blocked in the superficial circulation. This is the appearance of a subacute superficial phlebitis.

thigh in sufficient concentration to allow visualization for a longer time than about a minute.

We have seen one case in which the dye took a retrograde course through two valves into a communicating vein extending from the middle of the internal saphenous in the thigh. There was no evidence of block above this point or of dilatation or disease in either the internal saphenous or this connecting vein.

In pathological material, also, certain physiological observations have been made. The passage of the dye upward is definitely retarded in the presence of severe varicosities and in veins that are dilated and tortuous. Where the vein is blocked above the point where the dye is visualized, its upward passage may, of course, be delayed. In one case of early pregnancy we were not able to observe any delay in the upward passage of the dye, while in a case of late

Fig. 5. Block of superficial circulation in the mid leg. The dye goes up through the superficial and deep circulation to the mid leg. At this point, all of the dye passes inward to the deep circulation. This is the typical appearance of an acute superficial phlebitis.

pregnancy there was a very definite delay. The dye may remain in varicose veins for a considerably longer time than in normal veins.

A few cases have been seen in which a small portion of the deep circulation has been blocked by thrombosis or spasm. In these cases the dye passes upward through the deep circulation to the point of obstruction and then returns to the superficial circulation through connecting veins. Having continued upward to the region above the block, it again passes inward through the communicating veins to the deep circulation. Where a block occurs in the superficial circulation, because of phlebitis, the dye may turn backward by means of deep communicating veins to other superficial veins or into the deep circulation. In other words, it passes around a block in either the deep or the superficial circulation with surprising ease. As mentioned before, anastomoses between the deep and superficial veins are frequent and complete. The passage of blood containing the dye from deep to superficial circulation and vice versa in the leg and lower thigh seems very rapid. Retrograde flow of the dye has been seen with both deep and superficial block.

In the normal subject, where a larger vein which is not carrying any dye is joined by a smaller vein with a good concentration of dye the latter usually is not too diluted to demonstrate the entire lumen of the larger vessel. In the pathological case where the smaller vein is normal but the lumen of the larger vein is distorted, this distortion may be demonstrable by the dye.

Combining our knowledge of the anatomy of the venous structures with the knowledge of physiology which has been gained by venographic procedures makes it comparatively easy to interpret the gross pathological case. In the presence of old or recent thrombophlebitis, the first and most important observation is the complete absence of dye in part or all of the deep circulation. In cases of recent thrombophlebitis of the superficial vessels, a definite block and absence of dye in a portion of the superficial circulation can easily be demonstrated. With occlusion of the entire deep circulation, including the deep veins of the leg, the popliteal and femoral, the dye will go upward through the superficial veins. It gradually reaches the internal saphenous and the entire volume continues upward through this channel into the region of the femoral fossa. In most cases, at this point it passes inward and up through the iliac veins. We have seen one such case in which the block was of forty years' standing and numerous varicosities were present over the upper, inner portion of the thigh and lower abdomen. The dye passed up through the internal saphenous to about the mid-thigh, or slightly above. About half of it then passed out through a large superficial vessel into the varicosities and through

these spread upward to the abdominal wall.

One of the rather common findings in cases of thrombophlebitis has been the demonstration by retrograde filling of short sections of communicating veins extending away from the main trunk carrying the dye upward. This appearance has been helpful in completing the diagnosis of thrombosis. With a very recent phlebitis or an older phlebitis which is showing recanalization, the lumen of the vein may be grossly distorted. Occasionally, what appears to be the shadow of the thrombus itself is seen. In these cases, the wall of the vein, or the small area around the wall, will be demonstrated by means of a thin film of the dye which appears to pass along the wall and outline the defect in the center. Some cases of long-standing thrombophlebitis in which recanalization has apparently taken place show very irregular outlines of the vein lumen. The pattern of the dye, as it proceeds upward through the vein, is of irregular density.

We have seen one case in which the large veins of the thigh and leg were markedly calcified. This venous calcification differs considerably in appearance from calcification in the arteries. The picture is one of large, irregular plaques of calcium and it is evident that the lumen of the vessel is larger than that of the ordinary calcified artery.

Clinically, in a number of cases which pass the usual test for patency of the deep veins, venography has shown partial or fairly complete occlusion of most of these. This does not seem surprising in view of the very numerous anastomoses between the deep and superficial circulation and the extreme readiness with which the dye appears to pass from one to the other and back again. Certainly, venographic procedures make one wonder how it is possible to inject a sclerosing solution into any portion of the venous structures of the leg and expect that solution to stay where it is needed. In our experience venography has given a great amount of information not obtainable clinically. This information has shown the surgeon what procedure should be followed.

Fig. 6. Thrombus in an external vein. This is the typical appearance, as described by Bauer, of a thrombus in a vein. The dye is going up largely through the deep circulation, a small amount passing upward through the internal saphenous. This case was proved at operation.

SUMMARY

A serial method for the study of the venous structures of the leg has been described, and a number of anatomical and physiological observations have been recorded. From these physiological observations, we believe that pathological deductions can be made in most cases with considerable certainty. We feel definitely that this procedure should invariably precede any efforts to produce sclerosis or any operative interference with the veins of the leg. Finally, we would make a plea that the procedure be put into more general use and that more surgeons become acquainted with its value.

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DISCUSSION

S. H. Sedwitz, M.D. (Youngstown, Ohio): These studies were originally undertaken after observing the work done in Boston by Homans and Welsh, Fine and Sears, who employed venography for the purpose of detecting early postoperative thrombophlebitis. Even after infarcts were present in the lungs they injected diodrast (20 c.c., 35 per cent) into the distal vein, generally cutting down on the external malleolus to find a quite constant small vein that communicates with the deep circulation. One minute was required for the injection. In this way it was possible to demonstrate the presence of a blocked deep vein low in the ankle, the source of the emboli in the lungs. Fortunately, the necessity for such a demonstration is rare. Even after involvement of the lung has occurred, however, it is worth while to inject the leg. This does not involve any danger and may reveal the source of the infarcts and definitely clear up any question of differential diagnosis between atelectasis and embolus.

This phase of the work, however, is of less interest to me than its application to varicose veins. When a patient is seen with a thrombophlebitis of fifteen or twenty years' duration with evident varicosities and ulcers, the surgeon's impulse is to ligate and inject the involved vessels. Even after testing for the condition of deep circulation by accepted procedures, however, as I stated in a paper published in the *American Heart Journal*, I must admit I have had some bad results. In these unfortunate cases, where chemical sclerosing resulted in a choked leg, I have had to resort to hospitalization and active physical therapy, which involve loss of time and expense to the patient.

Up until a year ago, when we first started venography, I had 10 per cent postoperative complications following massive injection and ligation and section of the long saphenous vein. Since we instituted venography before operating I have had no such postoperative complications in 120 cases.

We employ venography routinely in patients giving a history of possible thrombophlebitis or chronic infected ulcers where there is a local infective thrombophlebitis in the region of the ulcer. It is dangerous to ligate the vein high up and inject it, blocking it from above, since this may lead to destruction of the collateral circulation. I would prefer to keep the varicosity and try to cure the ulcer by bandaging and other conservative measures rather than inject the vein and have the patient left with the ulcer and an edematous leg.

Another condition of interest is traumatic phlebothrombosis. Patients sustain injuries to the extremities resulting in lesions about the joints. There may be swelling and edema, as well as ecchymosis or establishment of a definite hematoma which can be seen. A venogram shows a blocked vein with a definite phlebothrombosis, which is extensive and progressive. Since it is painful and the patient does not undertake any active physical motion of the extremity, the thrombosis will extend to a valve, generally the saphenous femoral valve, where it is blocked. If in such a case a venogram is made immediately after traumatism, it can readily be seen where the vein has been broken and where the thrombus arises, and with superficial novocaine block the surgeon can tie off the vein and prevent the extension of the thrombosis. Medicolegally this is a very good point, since the adjusters cannot question the fact when a diagnosis of phlebothrombosis is made.

I was asked recently whether the injection of diodrast is contraindicated in the presence of a postoperative thrombophlebitis, whether it will incite loosening of an embolus. When there is a thrombophlebitis, the passage of blood or diodrast is prevented by the clot and it is shunted to other channels. The injection is given with a 26 or 28 gauge needle into a small vessel, very slowly and there is no possibility of dislodging an embolus. We have had occasion to inject diodrast following sympathetic nerve block with novocaine where the vessel is relaxed, but even under these conditions dislodgment has not occurred, so one need have no fear on that score.

I believe we are obtaining more exact information, free from doubtful interpretation, by taking our films in series. Where only one film is taken at the end of the injection (allowing one minute for 20 c.c.), the veins may show deficient filling, due to spasm, and faulty diagnosis may result. With serial films enough time is allowed between films to judge whether the deficiency is due to spasm or actual thrombosis.

The Roentgen Diagnosis of Biliary Tract Tumors[1]

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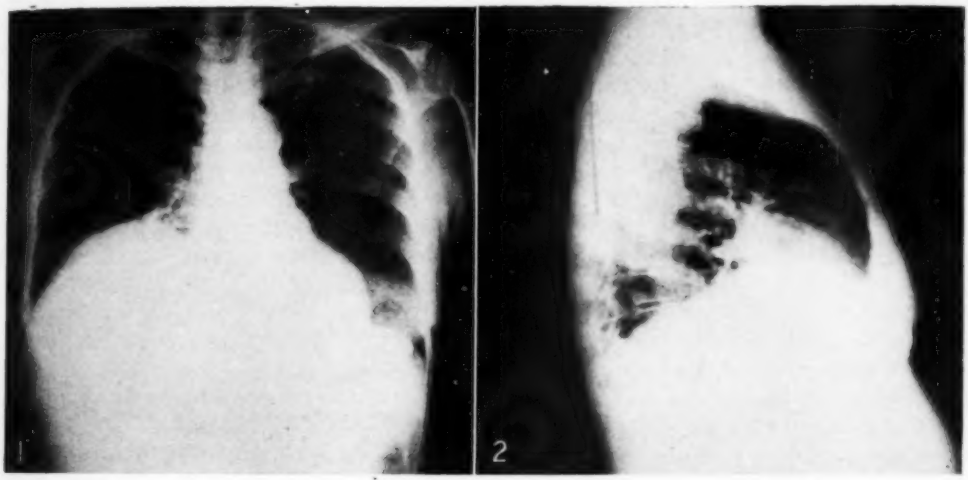
IN THIS DISCUSSION of the roentgen diagnosis of biliary tract tumors, the word tumor is being used in its larger sense, referring to all those organic lesions which are characterized by enlargement, be it inflammatory, non-inflammatory, or neoplastic.

Roentgen examination has proved to be most successful in the diagnosis of tumors of the liver, gallbladder, and extrabiliary ducts when it is carried out in a methodical order: first, a fluoroscopic inspection of the chest; second, a general survey of the abdomen with plain films; third, a study of the gastro-intestinal tract for any possible alterations in position and contour as a result of extrinsic pressure by enlarged neighboring organs.

The fluoroscopic inspection of the chest seeks to determine the presence of anything abnormal about the heart, vessels, lungs, and diaphragm. If any departures from normal are discovered, roentgenograms should be made, both anteroposteriorly and laterally. Attention should be paid particularly to the position, shape, and mobility of the diaphragm, which is often affected by abnormal conditions in the organs above or below it. One of the most frequent findings is unilateral elevation of the diaphragm on the right side as a result of an enlarged liver, subphrenic abscess, phrenic paralysis, atelectasis, or eventration. As a rule, the cause of the elevation is readily determined; if not, an examination of the stomach and bowels with a barium meal and enema may help to establish the diagnosis. It has been found that, with enlargement of the liver, the stomach and duodenum are displaced to the left and backward and the colon downward. In all other conditions the stomach and colon are usually pulled upward in the same direction as the liver.



Figs. 1 and 2. Elevation of the diaphragm due to enlargement of the liver: anterior and lateral views. In the lateral view the elevation of the diaphragm partially obscures the heart and lower dorsal spine. The relative position of the costophrenic angles is maintained and they are free.

In the presence of a subphrenic abscess the diagnosis is somewhat more difficult,

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

owing to the fact that the diaphragmatic elevation is brought about, not by the liver, but by the fluid between it and the diaphragm. Under this condition the liver may remain in normal position or may even be displaced downward, giving the impression of enlargement. Certain other changes, however, are frequently associated with subphrenic abscess, as, for instance, flattening of the elevated diaphragm with obliteration of the costophrenic angles. This picture differs from that in elevation due to all other conditions, in which the arc-like configuration and the relative position of the costophrenic angles are maintained (Figs. 1 and 2).

The degree of mobility of the diaphragm has not proved to be of great use in the differential diagnosis, being more or less impaired under all circumstances.

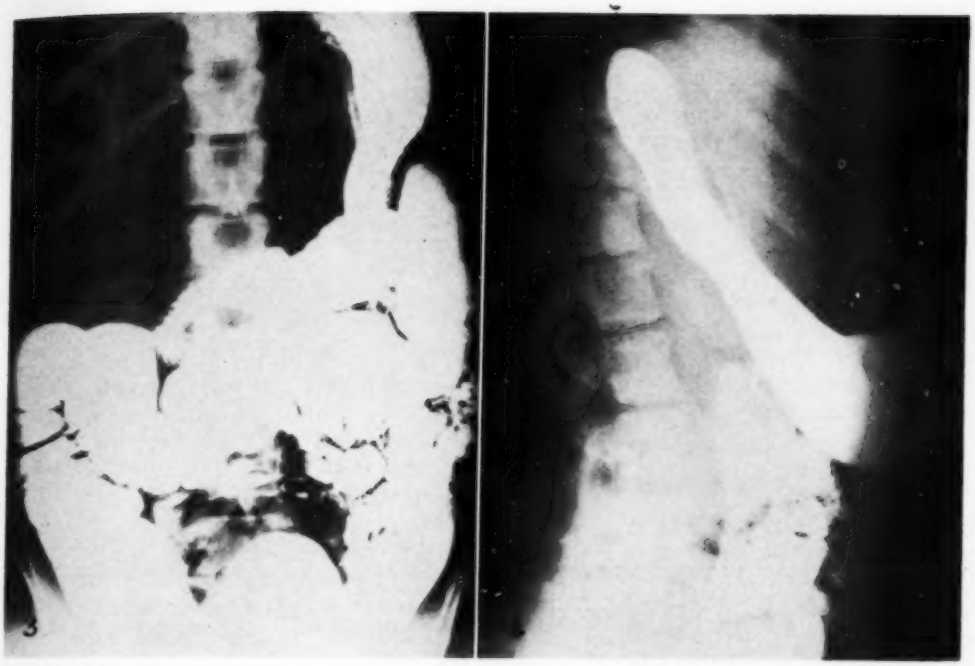
The second step in the roentgen examination consists in taking plain anteroposterior views of the abdomen and, at times, lateral views as well. The value of the plain views for a general survey of the abdominal structures is too well known to require any special emphasis; yet, it is often overlooked by radiologists. The information obtained is at times sufficient to establish a correct diagnosis, while at other times it may reveal an important hint about an organ deserving of special attention.

Besides the anteroposterior and lateral views, it has often been found advantageous to make use of the left anterior oblique position in order to separate the shadow of the right kidney from a superimposed shadow of a large gallbladder. In this position the shadow of the gallbladder is displaced to the right of the kidney.

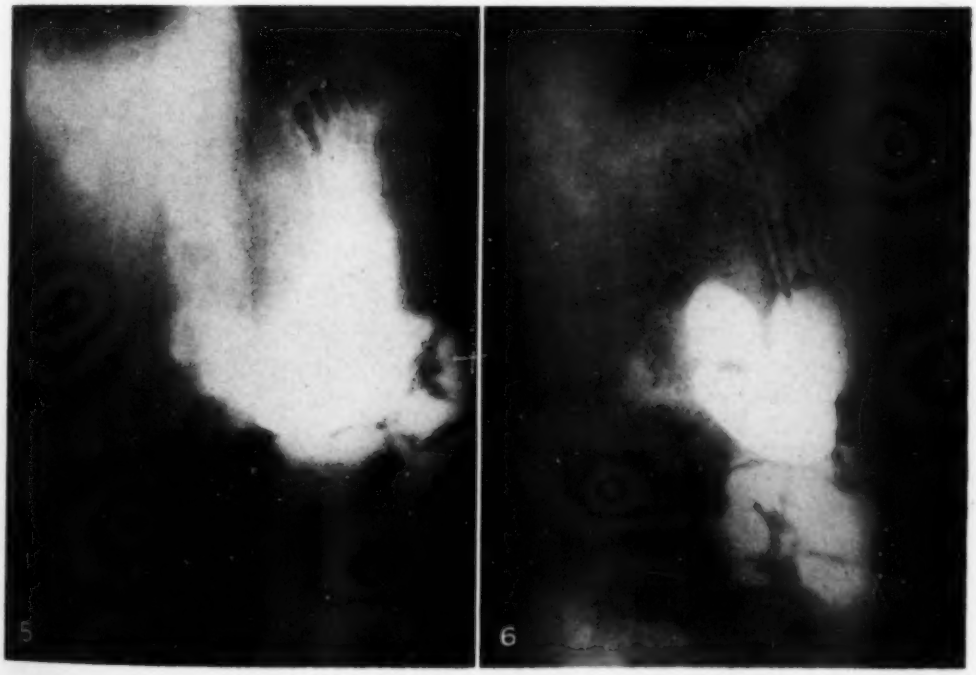
The final step in the roentgen study consists in the examination of the gastrointestinal tract with the aid of a contrast meal and enema, but not for its own sake, since only extra-gastro-intestinal tumors are being considered. The purpose is to determine the existence of any deviation in the position and contour of the hollow viscera as a result of extrinsic pressure on the part of an enlarged adjacent structure. Under normal conditions the organs in the abdomen occupy a definite place and bear a constant relation to each other. In the presence of an enlarged organ or mass, the position and contour of the stomach and bowels, which are, relatively speaking, freely movable and flexible, will assume a certain characteristic pattern and direction according to the position of the body as a whole and the particular organ affected. A knowledge of these facts has often helped in arriving at an accurate conclusion as to the presence, location, and origin of tumors of the biliary tract.

The following changes in the stomach and bowels have been observed in the presence of an enlarged liver. With the patient in the recumbent position, the stomach and duodenum are displaced to the left in the anterior view (Fig. 3) and backward in the right lateral (Fig. 4). In the presence of a tumor arising from the right kidney or the retroperitoneal lymph nodes the stomach and duodenum are similarly displaced to the left, but in the right lateral view the displacement is forward instead of backward. A tumor originating from the gallbladder will also displace the stomach and duodenum to the left (Fig. 5), but in the right lateral view there is no displacement, either forward or backward (Fig. 6), since the gallbladder lies neither behind nor in front of the stomach, but only at its side in the same plane.

In the roentgen diagnosis of tumors of the common duct a knowledge of the exact relationship between the gallbladder, ducts, pancreas, and duodenum is essential. Attention is especially called to the position of the neck of the gallbladder and the cystic and common ducts, surrounding the duodenum at the superior angle on three sides, and forming, together with the head of the pancreas against the inferior surface, a clamp-like tubular structure around the circumference. In view of the above anatomical relationship, it is obvious that anything which increases the caliber of the tubular system around the duodenum may produce some degree of pressure whereby a defect in its contour



Figs. 3 and 4. A case of enlarged liver. In the anterior view (Fig. 3) the stomach and duodenum are displaced to the left and the colon downward. In the right lateral view (Fig. 4) the stomach is seen to be displaced backward as well.



Figs. 5 and 6. A case of enlarged gallbladder. The anterior view (Fig. 5) shows displacement of the stomach to the left. In the right lateral view (Fig. 6) the stomach and duodenum are displaced neither backward nor forward. Note the pressure defect at the superior angle of the duodenum due to a common duct tumor.

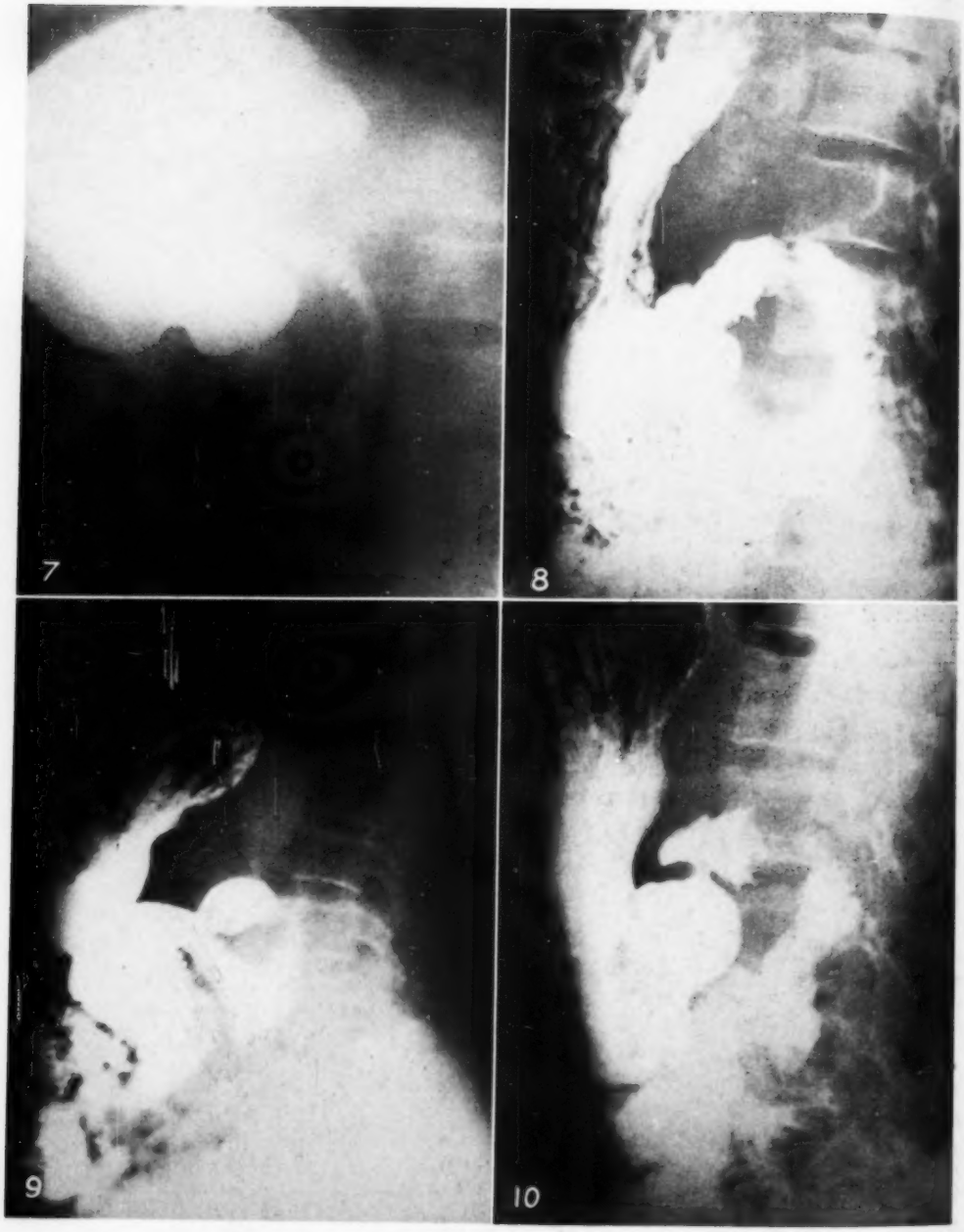


Fig. 7. Right lateral view, showing the normal position, shape, and relation of the duodenal loop surrounding the head of the pancreas.

Fig. 8. Right lateral view showing duodenal loop of normal size, with pressure defect at the superior angle due to dilatation of the common duct as a result of a new growth in a case of obstructive jaundice.

Fig. 9. Right lateral view showing enlargement of bulb, with deformity at the superior angle due to a new growth of the common duct in a case of obstructive jaundice.

Fig. 10. Right lateral view showing duodenal loop of normal size, with pressure defect at the superior angle due to a stone in the neck of gallbladder, in a case without jaundice.

may result. This has been found to be the case in many common duct obstructions.

In an earlier paper, which dealt with the diagnosis of pancreatic tumors, attention was called to a pressure defect in the contour of the duodenum in the region of the superior angle or thereabouts which was observed in the presence of obstructive jaundice. On operation or at autopsy in such cases the common duct was found to be dilated to a greater or less degree in every instance, the cause of the dilatation being either a new growth or stone in the common duct. Since then a considerable number of similar cases have been studied and the previous observations have been fully confirmed.

The most satisfactory view for demonstrating the pressure defect in the duodenum is the right lateral or right anterior oblique, with the patient lying on the horizontal fluoroscope. In this position the entire duodenal loop is seen in its true perspective surrounding the head of the pancreas (Fig. 7). The diameter of the duodenal lumen varies more or less during the passage of the barium meal depending upon its tonicity and the quantity of the opaque medium present. Under normal conditions the contour remains fairly regular throughout the entire course, so long as there is a sufficient amount of the contrast medium. In some cases of biliary tract disease an interruption in the passage of the barium mixture was noted at or just beyond the superior angle of the duodenum. This interruption manifests itself by a defect in the contour of greater or less degree (Fig. 8). In some cases the defect is transient, while in others it may be of a more permanent nature. In the latter event, there are signs of obstruction, as shown by delay in the passage of the opaque medium and often by dilatation of the bulb (Fig. 9). In a number of cases, where such defects were found, operation or postmortem study revealed a dilatation of the common duct, cystic duct, or neck of the gallbladder, explaining the pressure defect upon the duodenum. This roentgen sign has been found to be present in practically every case of obstructive jaundice due to a stone or a new growth in the common duct. The sign is absent, however, in non-obstructive jaundice, a very important differential point in some obscure cases. It was also found to be present in several patients without jaundice. Upon operation it proved to be due to large stones lodged in the neck of the gallbladder or cystic duct (Fig. 10).

CONCLUSION

This paper discusses the roentgen diagnosis of tumors of the liver, gallbladder and extrabiliary ducts. Attention is called to the frequency of elevation of the right side of the diaphragm as a result of an enlarged liver and the method of differentiation from other conditions which affect the diaphragm in like manner.

Attention is also called to the displacement of the stomach and duodenum to the left and backward in the presence of an enlarged liver and to the left only in the case of gallbladder enlargement.

Special emphasis is placed upon the roentgen demonstration of a defect in the lumen of the duodenum, in the region of the superior angle, due to pressure from dilatation of the neck of the gallbladder, the cystic or common duct, as the result of obstruction from a new growth or stone.

Several roentgenograms are presented illustrating tumors of the liver, gallbladder, and extrabiliary tract.

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Roentgen Rays in the Treatment of Cervical Lymphadenitis[1]

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AS EARLY AS 1898 Pfender mentioned roentgen rays in the treatment of scrofula, and in 1903 Pfahler and others published the first reports of encouraging results following radiotherapy of tuberculosis of the lymph nodes. Since then many clinics have demonstrated the value of roentgen rays in the treatment of cervical lymphadenitis, indicating that roentgen irradiation is one of the most important therapeutic agents in the management of that disease. In 1922 Lahey and Clute reported the end-results of surgical treatment but they emphasized that the best results were obtained in patients who were treated early and in whom complete excision of the nodes was possible; if sinuses or abscesses were present, chances of complete cure were not so good. In 1940, Lahey, Hare, and Haug showed that 80 to 90 per cent of patients responded to x-ray radiation, so that radical operative measures proved unnecessary. They stated that radical operation leaves poor cosmetic results and that there is a higher percentage of recurrence when surgery alone is employed. For these reasons, radical surgery is now rarely resorted to. Well guided surgery, however, in conjunction with irradiation can be considered as the most practical method in the management of this condition.

The follow-up of a group of patients demonstrates the satisfactory results of irradiation. Since tuberculous cervical lymphadenitis is an inflammatory process, frequently of marked chronicity, the rationale of the treatment adopted is based on the known favorable effect of small doses of roentgen rays upon inflammatory conditions. In some cases the tuberculous process within the node runs a comparatively short course. The elapsed time between the apparent onset of the disease and healing varies from several weeks to several months, or even years.

TYPE OF MATERIAL

In planning treatment and anticipating results, one must consider the hereditary and economic background of the patient as well as the extent of the lesion. The run-down, undernourished, overworked patient of poor social and economic status who lives in crowded unhygienic quarters will respond more slowly to therapy. Race and nativity are likewise contributory factors. Many of our patients are Negroes and Puerto Ricans, among whom a change of climate and living conditions results in a higher incidence of the disease. This condition resembles the childhood type of tuberculosis and is seen most commonly in Negroes between the ages of sixteen and forty years.

FINDINGS AND COURSE

Early diagnosis is of the utmost importance. Hyperplastic nodes may be present for years, giving few or no symptoms, and frequently are neglected by the patient. As the disease progresses, however, the breakdown of a node together with local inflammation and pain, and general weakness occasionally accompanied by low-grade fever, night sweats, and loss of weight cause the patient to seek medical advice. The involved lymph nodes are enlarged, discrete, and most often located in the posterior triangle of the neck, either unilaterally or bilaterally. Unless they break down, they are sharply outlined and well circumscribed. There is little or no associated mediastinitis.

The nodes may attain huge proportions before breaking down. On the other hand,

[1] From the Radiation Therapy Service, Dr. Ira I. Kaplan, Director, Bellevue Hospital, New York, N. Y. Presented before the Radiological Society of North America at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

caseation and necrosis may occur early. In the beginning stages, the physical findings are meager and in many instances remain obscure until a careful complete examination, including biopsy and roentgenograms of the chest, is done. The sputum is usually negative, and biopsy and roentgen studies are therefore of prime importance. In pulmonary tuberculosis of adult type, enlargement of the cervical, supraclavicular, hilar or mediastinal nodes is usually not demonstrable and, while there may be involvement of the mediastinal nodes, the appearance of the parenchymal lesion is far more obvious and is frequently the only diagnostic consideration. In mediastinal tuberculosis, on the other hand, the formation of large masses of nodes is readily demonstrable on roentgen examination of the chest. In children there is practically always associated lymph node involvement.

In patients with involvement of the supraclavicular nodes, the process may extend to the mediastinum or along the trachea, occasionally producing actual displacement. Small calcified nodes, observed in chest roentgenograms, indicate old tuberculous lesions which have healed. In some instances, these are the only evidence of tuberculous infection, while other patients show additional scars of old primary foci in the apices or scattered throughout the parenchyma of the lungs. In hyperplastic lymph node tuberculosis there is generally no evidence of parenchymal involvement of the lung until the later stages. When, however, the nodes are of the fibrocaseous variety, there may be early minimal or extensive pulmonary infiltration.

The size and contour of the nodes in many borderline cases do not determine the diagnosis, since the presence of disease can be established only by the clinical and physical findings, with biopsy or culture. The subsequent clinical course and comparative roentgen studies made at frequent intervals prove that the adenopathy is characterized by a hyperplastic reaction of the lymph nodes to the infecting organism. The therapeutic roentgen test has proved helpful; if the enlarged nodes are of inflammatory origin they will respond by regression. The general management of this type of case involves hygienic measures, as rest, adequate diet, and favorable surroundings, such as are indicated in the treatment of other forms of tuberculosis.

Four hundred and nineteen patients with lymphadenopathy were treated in the Radiation Therapy Department of Bellevue Hospital during 1924 to 1941, inclusive. Routine chest examinations were done in all cases, and the impression was gained that tuberculous cervical adenitis is not often associated with active tuberculous involvement of the lungs. When tuberculous nodes are situated in the supraclavicular area or in the axilla, however, there is usually an associated active pulmonary tuberculosis. Of the 419 patients, 305 had positive biopsies and in 12 positive tuberculous cultures were obtained from aspiration of the fluctuant nodes. The remaining 102 patients were accepted for therapy because of the clinical findings, despite the fact that in most of these biopsy did not show tuberculosis.

TREATMENT

No standard method of treatment for all patients is possible. The factors used vary with age, race, and extent of the disease. In children and younger patients with superficial lesions, low-voltage or medium-voltage x-ray therapy was given. The factors used were 100 to 120 kv., 5 ma., 2–4 mm. Al, 30 to 40 cm. T.S.D., portal sufficient to cover the area involved; 100 r were given at a treatment once or twice a week, up to a total of 600 to 800 r, measured in air. In colored patients pigmentation of the skin is frequently seen after one or two treatments; continuation of therapy in these cases is guided by the clinical response. Incision and drainage are frequently necessary when the mass becomes fluctuant.

In patients with deep, large nodes, particularly where several nodes had become confluent, deep x-ray therapy was

employed, the factors in these instances being 200 kv., 5 ma., 0.5 mm. Cu, + 1 mm. Al filter; 0.9 H.V.L., 40–50 cm. T.S.D.; 100–150 r were given at a time, one area being treated twice a week. The size of the irradiated field varied with the extent of the lesion. The total dose given was 700 to 900 r in air. This was repeated if necessary in six to eight weeks.

ANALYSIS OF RESULTS

Regression and healing of the nodes and sinuses were usually so complete that hardly a trace of the original lesion could be detected. In 310 of the 419 cases follow-up observations are available. Of these, 140 received one course of therapy, while two, and even three courses were necessary in others. Pain and tenderness were relieved after the first course of therapy. In many cases, however, with draining sinuses, healing occurred only after the second or third course of therapy. We found no characteristic histologic structures which would serve as an indication of a favorable response or resistance to radiation therapy.

All types of cervical adenitis were treated, including (1) small isolated nodules, (2) multiple nodes of various sizes, (3) large masses of confluent nodes, (4) fluctuant masses, many with draining sinuses.

X-ray examination of the chest was done routinely in all cases. Active tuberculosis was found in 19 patients, suspicious activity in 30, interstitial changes in 102, calcified foci in 109. One hundred and sixty patients showed no chest lesions.

In 9 patients active pulmonary tuberculosis developed following therapy, an occurrence which can possibly be explained on the basis of known pathologic changes and the probable pathogenesis of the disease. It is probable that the cavities first observed on routine periodic examination of the chest were uncomplicated tuberculous lesions, and that the progress of the latent tuberculosis was aggravated by roentgen therapy. It is generally known that the activity of exudative tuberculous lesions is increased and that caseation is accelerated by irradiation. In these patients, therefore, a quiescent tuberculous focus may have been activated or the pulmonary parenchyma may have been rendered more vulnerable to tuberculous infection.

The age incidence in this series varied from three weeks to seventy years, the largest age-group being that from twenty to thirty years. There were about the same number of male and female patients, showing that there was no sex predilection. Both sides of the neck were equally affected. Bilateral involvement was seen in some patients, while some had axillary, inguinal, and/or mediastinal node involvement. In 310 patients followed there was complete disappearance of the lesions in 178, partial disappearance in 101, and slight improvement in 31.

The follow-up in a large municipal institution, such as Bellevue Hospital, is not entirely satisfactory, since many patients do not return. Many feel that if the condition is improved there is no necessity for further visits; the economic status of many patients does not permit frequent revisits, while a considerable number move frequently, without leaving a forwarding address and cannot be reached by letter or by the social worker.

SUMMARY

1. A study of 419 patients indicated that roentgen therapy combined with well guided surgery is the most practical method of treating tuberculous lymphadenitis.

2. The radiation technic varied with the case. Both low-voltage and high-voltage x-rays were used.

3. It was found that active pulmonary tuberculosis was present or developed subsequently only if the supraclavicular, axillary, or mediastinal nodes were involved.

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A Review of the Scott Wide Field X-Ray Treatment[1]

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WIDE FIELD x-ray treatment as developed by the late Dr. S. Gilbert Scott[2] of London consists of treatment with small doses of low-voltage x-rays, applied to the body from the head to the upper part of the lower extremities, both anteriorly and posteriorly. It is given for its tonic or stimulating effect on the body as a whole, and not for the destruction of any disease. It is intended to build up the resistance of the body to disease. The individual and the total doses are small. The amount of dosage and the interval between treatments must be judged by the tonic effect upon the body as a whole.

The method was first described by Scott in the *British Medical Journal*, May 1921. It was further developed under the Nuffield Research Fund and published in October 1939 in book form, in connection with the Nuffield Wide Field X-ray Therapy Research Fund.

In 1938, Scott was invited to give the Mackenzie-Davidson Lecture before the British Institute of Radiology (corresponding to the Caldwell Lecture before the American Roentgen Ray Society, the Carman Lecture before the Radiological Society of North America, and the Janeway Lecture before the American Radium Society). He chose this for his subject. He says: "The method must be used for its general stimulating effect," and quotes Pasteur's last words to Renan: "Claude Bernard was right, the microbe is nothing, it is the soil which is all important," and Hippocrates: "The only scientific way of treating disease is by treating the whole body."

The center for Scott's study of this method of x-ray therapy was the Charterhouse Rheumatism Clinic, 56 Weymouth Street, London, W1, and he invited anyone interested in the work to see how the method is applied. I knew Scott for seventeen years and was a guest at his home, but I never found the opportunity of visiting the Clinic, because I had not heard of this method until he sent me his book in 1940. Even then the theory seemed fantastic to me, and I did not start to use the method until six months ago. I have no personal conclusions to report other than that I have found no harmful effects from this method.

I have been doing x-ray therapy during more than forty-two years, and I am convinced that we have much to learn. The skillful application of x-ray therapy involves a great deal more than a knowledge of physics, which is admittedly very important. The biological effects upon the body as a whole, and upon the tissues surrounding the diseased area, the blood, the endocrine glands, and their secretions, etc., as well as the quality of rays, the size and proper distribution of the tissue dosage, and the interval between doses, need much study. Scott's method was applied by him beginning in 1918—twenty-four years ago—yet it will seem revolutionary to most of us.

Scott began his research upon this subject in 1920–1921, at the London Hospital. The first 50 cases submitted to wide field x-ray treatment were under constant observation during one year, with the main object of determining whether any harm was being done. Instead of harm, an all-round improvement was observed in every case. There was nothing to suggest anemia or leukopenia in any instance. Several of the patients were shown about this time at the Royal Society of Medicine, and the method was described in the *British Medi-*

[1] Presented before the Radiological Society of North America, at the Twenty-eighth Annual Meeting, Chicago, Ill., Nov. 30–Dec. 4, 1942.

[2] S. Gilbert Scott, M.R.C.S., L.R.C.P., F.F.R., D.M.R. & E. (Camb.), Consulting Radiologist to the London Hospital; Honorary Radiologist to the British Red Cross Rheumatism Clinic, Lond.; Honorary Physician Radiologist to the Charterhouse Rheumatism Clinic.

cal Journal for May 1921. The method became established at the London Hospital as a routine prophylactic measure in all cases of malignant neoplasms, being *used as an adjunct* to the heavier local application of the x-rays to the primary growth. While Scott was not able to collect enough reliable data to justify a statistical report of his results, he nevertheless wrote: "I am personally so convinced of its therapeutical value, that I have never ceased using it in all cases of malignant disease as a method of treatment to be employed where necessary in conjunction with the heavy local radiation to the primary growth."

We all know how difficult it is to draw scientific conclusions from purely clinical observations, and we must realize, therefore, that Scott was giving us his personal impression rather than scientific proof.

During 1933 the "differential sedimentation test" (D.S.T.) was introduced. This was based upon the work of Bendien, and an improved technic was developed by Coke and others.[3] The ordinary sedimentation test was found to be of some value, but the D.S.T. was found to be much superior and proved to be an excellent gauge of the constitutional change, corresponding to the clinical results. This test was used by Scott as a guide in determining his results. This test showed that the greatest deviation from the normal seemed to occur in the *serum* of the active or chronic infective or chronic allergic case, and it is in those cases in which the sedimentation rate is raised and a definite abnormal condition of the blood serum is present that the best results are obtained by the wide field method of x-ray treatment. While this test is not essential or used in the routine case, it has been found of great value in determining the correct saturation point and in avoiding oversaturation. A considerable number of cases of spondylitis have now been treated by this method and the D.S.T. has been used in conjunction with the treatment.

[3] The Charterhouse Rheumatism Clinic Original Papers.

Scott says: "I suggest that x-rays should be considered as the most powerful and possibly the most valuable therapeutical agent in medicine."

TECHNIC

Scott's investigations have shown that the essentials of success with wide field x-ray therapy are as follows: (1) a heterogeneous primary beam, using x-rays of the long medium wave length with appropriate filters; (2) a large field, which must include the whole trunk; (3) optimum distance of the tube to the patient (20 inches); (4) correct choice of case; (5) correct adjustment of dose for the particular patient; (6) familiarity with the signs of saturation.

Wave Length: Grotthus' Law (1818) reads: "Only those rays which are absorbed can produce chemical changes." The technic recommended by Scott is: 130 kv., 3 mm. Al, 60–100 r, half the dose being given anteriorly and half posteriorly, at 50 cm. distance.

Field: Investigations have shown that to obtain the desired constitutional effect, the abdominal area—that is, the area below the level of the diaphragm—must be included in the radiation field. In asthma a certain modification has been introduced for various reasons, so that only the abdominal area is submitted to irradiation, the thoracic section being entirely excluded. With this single exception, the whole trunk is always included in the radiation field. It is technically difficult to obtain a large enough field at the optimum distance of 20 inches. The inclusion of the thyroid gland found at one extremity of the field and the genital organs at the other is advisable even though the dose actually received by these organs is small due to their situation at the periphery of the radiation circle.

Reaction: Usually vague abdominal discomfort, sometimes described as biliousness, or slight nausea occurs within twelve hours after treatment. Under no circumstances should the patient experience more than this, for the sedimentation rate

and differential sedimentation test have shown that there is otherwise a risk of creating a so-called "negative phase," a condition that, if continued, may be detrimental to the patient.

CONCLUSIONS

In presenting this review of Scott's method of "wide field x-ray treatment," I am giving to you nothing that is original with me, but when a friend and British colleague presents to us his observations covering a period of more than twenty years, they deserve serious consideration. His distinguished hospital connections, the fact that his investigations were made under a Fund established for this purpose by Lord Nuffield, and the invitation of the British Institute of Radiology to give the Mackenzie-Davidson Lecture at its Annual Congress in 1937, give Scott's observations more than ordinary prestige.

I have been using this method in conjunction with my regular local treatment in a considerable number of cases during more than six months and have seen no harm. I believe I have seen some benefit.

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DISCUSSION

Helen B. Flynn, M.D. (Chicago, Ill.): I have studied cancer from the standpoint of the infectious theory and I can see some wonderful things in the wide spread x-ray technic, but a word of caution should be given. Watch your patients when you use it. Each one will respond differently.

What x-ray treatment does, whether it is high-voltage or low-voltage, whether it is concentrated or disseminated, is to kill off the cause of the disease and, as every bacteriologist knows, regardless of what the organism is a certain amount of toxemia results. To take, as an example, the treatment of granulomata: in the patient with a severe infection the liberation of large amounts of toxin will produce a result quite different from that in the patient with a low-grade toxemia, and this holds good not only in cancer but in all the granulomata—syphilis, tuberculosis, etc. *When you are x-raying a patient, watch for the degree of toxemia following treatment.*

Ira I. Kaplan, M.D. (New York): I would like to recall to Doctor Pfahler what we saw in England back in 1922 in Knox's laboratory. He had a big wagon wheel fixed to the ceiling and attached by a belt to a gas engine. On the wheel was an x-ray tube. The patients were stretched out on the floor in a sort of sundial effect, the gas engine was started, and as the wheel turned, the radiation was distributed to the patients for what it was worth.

Another method was that of Dessauer in Germany, probably in 1921 or 1922. The patient was placed in a box in which there was a rotating x-ray tube so that he received a box-like effect of radiation all over the body. Scott's method seems to be somewhat similar in purpose.

Joseph Ernest Gendreau, M.D. (Montreal, Quebec): Wide field irradiation has been used for many years, and at different meetings in Europe papers have been presented describing it. We have long used the method in Montreal. In fact, one of our fifteen tubes is devoted exclusively to that form of therapy. We use 200 kv. and a distance of 1 or 2 meters. The method is, however, dangerous. I know that in Europe cancer patients have died following its use.

This method of treatment must be carefully studied. Astonishing effects are shown with very small dosage. Even with 25 r we have had some surprising results. Effects on the blood are, of course, sometimes distressing. Such therapy has been used for generalized cancer, Hodgkin's disease, and similar conditions with satisfactory reactions. Improvement has also been obtained in benign conditions, but the danger is so great that prudence must be the rule.

Perhaps we do not use the same way of measuring, but 150 r is a huge dose; 25 r is a moderate dose, and 50 r repeated may cause serious discomfort and danger.

There remain certain questions for study. How, with such small dosage, can we obtain favorable results that are certain? How is the general reaction of the body to be explained? Some adequate explanation, aside from the volume involved, must be found. Meantime, in proceeding with the method we must be very prudent, awaiting more scientific study and adequate statistics.

Merle Franklin Godfrey, M.D. (Glendale, Calif.): It was my privilege to be associated with Dr. Gilbert Scott for a number of months in London, both at the Charterhouse Rheumatism Clinic and at the British Red Cross Rheumatism Clinic, in the year 1935. I did not know that he had done anything in the treatment of cancer with this form of irradiation.

I did have the opportunity, however, of watching the effects he obtained in cases of spondylitis adolescens, particularly as associated with pathology of the sacro-iliac joints, as well as to observe his work in patients with asthma. Results in cases of both types were gratifying, as conceded not only by Doctor Scott but by all the men connected with both clinics.

Actually, about 35 per cent of asthmatic cases

seemed to be considerably improved by this wide field therapy. I won't say that they were "cured," but the patients appeared better and stated that they felt better. This physical improvement was usually paced by improvement in the findings by the differential sedimentation test, as devised by Coke, Crowe, and Scott.

I saw no ill effects following Doctor Scott's technic. There may have been some, however. These patients seemed to get a physical lift and I believe that those who react badly, as mentioned by one of the discussants, are probably those in whom curious metabolic changes take place, releasing toxic substances which act as a systemic poison.

George E. Pfahler, M.D. (*closing*): I think we must first of all understand clearly that the treatment I am describing (not my own) is not the teleroentgen therapy which has been used for the most part to destroy disease. I stated that quite definitely in my introductory remarks.

This treatment is given for its stimulating effect on the resistance of the body; in other words, for its stimulating effect on the normal tissues and not for its destructive effect on any disease. The destructive effect on the disease must come from the stimulating effect on the normal tissues. That is why I did not bring into the discussion the work that has been done, not only in Europe but in America, on whole body treatment with high-voltage rays such as is recommended by some for leukemia. Dr. Lloyd Brown did a considerable amount of work on treatment of the whole body. That is a different problem entirely.

There is another point I should like to bring to your attention. When the whole body is treated with any dose (Doctor Quimby can tell you this much better than I), one gets a constitutional effect in great part according to the volume of tissue that is treated. Let us say, for example, that we give 100 r to a field 10 × 10 cm. When the same dose is given to the whole body, that field is multiplied many, many times and the constitutional effect will be correspondingly greater. We must always keep that in mind.

With regard to the use of the high-voltage treatment, we are all convinced, I think, that the damaging effect on the blood stream is particularly by those rays that pass through the bony tissue. The low-voltage rays and small doses produce no damage to the blood-making organs, as observed by Doctor Scott.

An Apparently Solitary Myeloma of Bone with Subsequent Generalization[1]

Favorable Response to Irradiation with Unusual Reactions

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ACCORDING TO THE latest reports (Paul and Pohle; Bichel and Kirketerp; King; Tilden; Esposito), 48 cases of so-called solitary myeloma have been recorded in the literature. Only about one-fourth of these, however, are known to have remained solitary after four years' observation. In approximately 30 per cent the typical picture of multiple myeloma developed after varying intervals and 40 to 50 per cent were observed too short a time to permit a definite conclusion. Bichel and Kirketerp, emphasizing the importance of sternal puncture as a diagnostic aid, accepted as unquestionable solitary myeloma only 5 of a series of 27 cases which they reviewed, mainly on the basis of their long clinical course. They believe that a roentgenographic investigation of the entire skeleton does not wholly exclude the possibility of a generalized myelomatosis in the presence of a single roentgenologically demonstrable lesion, inasmuch as sternal puncture in their two cases showed evidence of systemic disease when roentgenologically no other lesion could be found.

It is a matter of speculation whether these tumors, *i.e.*, the ones which remained solitary after four years' observation, and those which ultimately became typical multiple myelomas, are really representative of two different entities. The important point is that all of these lesions apparently have a better prognosis and respond more favorably to treatment than the classical multiple myeloma. Paul and Pohle incline to the belief that myeloma may occur in varying degrees of malignancy, with rapid progress in the classical cases and a relatively benign course in the so-called "solitary" lesions. Between the two extremes—*i.e.*, the typical multiple myeloma and the probably permanently solitary tumors—many grades of malignancy may be found. This assumption naturally would favor the outlook in cases with early institution of proper treatment.

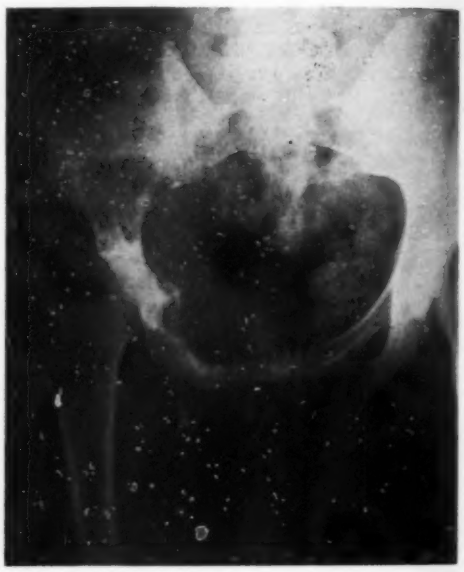

Fig. 1. Roentgenogram of the right hip, Oct. 20, 1939. There is a practically complete destruction of the entire superior ramus of the right pubic bone, with some faintly seen flake-like remnants of bone, suggestive of expansion. The destruction involves the acetabulum as well as part of the innominate bone. This latter involvement is purely osteolytic, with coarse trabeculation and lack of periosteal reaction or bone production. Probably some soft-tissue infiltration is present.

From the *roentgen diagnostic* point of view, two main types of lesion have been described. The first is the purely osteolytic lesion with sharp demarcation and little, if any, expansion. This type is most frequently located in a single vertebra or the shaft of a long bone and is easily mistaken for an osteolytic cancer metastasis.

[1] Presented before the Buffalo Radiological Society, Jan. 11, 1943. Accepted for publication in April 1943.

The second, or so-called giant-cell, type is a multicystic, osteolytic, destructive lesion, with rather sharp demarcation and occasional expansion. According to various reports (Paul and Pohle; Pasternack and Waugh), the giant-cell type seems to show less tendency toward generalization and perhaps a better response to treatment, especially to irradiation.

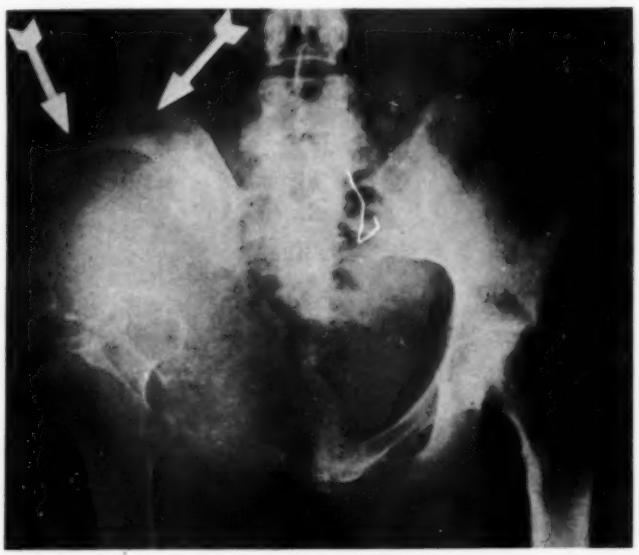

Fig. 2. Roentgenogram of the pelvis, Oct. 22, 1941, showing destructive changes in all the right pelvic bones. Note the two small punched out areas of destruction in the upper remaining rim of the innominate (arrows). Definite soft-tissue involvement is present. Beginning destruction of the left pubic bone at the symphysis is also present.

The case to be presented here was probably of the giant-cell type and apparently originated in the superior ramus of the right pubic bone, with subsequent involvement of the right ischial, innominate, and left pubic bones. Contrary to the statement of Stewart and Farrow, that *bulky* plasma-cell myeloma is radioresistant, there was a favorable response to irradiation in our case. The post-irradiation changes constitute the main subject of this report.

CASE REPORT

G. S., a 53-year-old white female, was admitted to St. Francis Hospital, Olean, N. Y., on Oct. 31, 1941. Her chief complaints were pain in the right hip and thigh and inability to walk. She attributed her trouble to a fall about seven years previously, in which she landed on her right hip. About five years before admission she began to have pain in the hip and difficulty in walking. These symptoms gradually increased in severity. Finally in 1939, that is about three years after the onset of the pain, she consulted her physician. At that time, save for the right hip region, nothing essential was found on physical examination. The right lower extremity showed a slight generalized atrophy together with some tenderness in the right hip region. The attending physician advised hospitalization and x-ray investigation.

On Oct. 20, 1939, the patient was admitted to a hospital and an x-ray examination of the pelvis was done for the first time (Fig. 1). The tentative diagnosis (Doctor Jaffrey) was a primary malignant bone tumor, possibly chondrosarcoma, osteogenic sarcoma, or plasma-cell myeloma. A chest roentgenogram at this time was entirely negative. Reexamination nine months and again eighteen months later showed the lesion to be progressing, but there was still no evidence roentgenologically of pathological changes in the chest.

On Oct. 22, 1941, just two years after the first roentgen study, the patient was admitted to St. Francis Hospital. The right leg was now about 1 1/2 inches shorter than the left. The right thigh measured about 2.0 cm. and the right calf 0.5 cm. less than in the left lower extremity. On rectal

and vaginal examination, a large, smooth, firm tumor could be palpated on the right side. The movement in the right hip joint was not noticeably limited. The patient, however, was unable to walk without crutches.

On the day of admission, roentgenographic examination of the pelvis revealed advanced destruction in all the right pelvic bones (Fig. 2). An entirely osteolytic lesion was present, with coarse trabeculation in the innominate bone and perhaps some expansion in places. The outline of the destruction was quite smooth in places but mostly

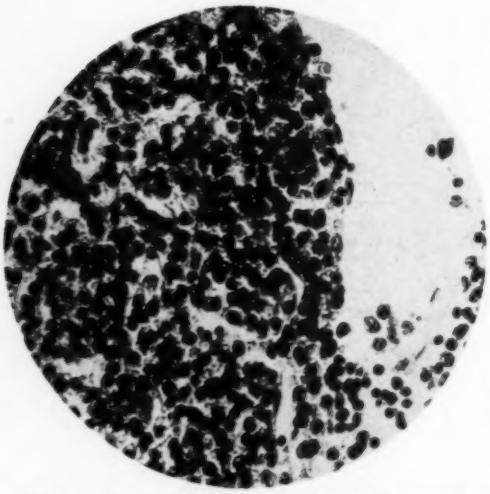

Fig. 3. Section of tissue (× *c* 300) from tumor of right pelvic bones. Note cellular neoplasm with scanty stroma. The nuclei are occasionally located eccentrically and many reveal a somewhat spoke-like arrangement of the chromatin.

irregular. Soft tissue involvement was present. An especially interesting feature was the presence of at least two small, somewhat punched-out areas of destruction in the upper remaining rim of the right innominate bone, demonstrable on repeated examinations. This finding definitely established the condition as of a multiple—rather than the earlier single—lesion type. A beginning irregular destruction of the left pubic bone at the symphysis was also demonstrable, with suggested involvement of the symphyseal fibrocartilage. These latter findings, the age of the patient (fifty-three), and the location of the tumor were somewhat at variance with the typical picture of the ordinary giant-cell tumor (which was considered as a first possibility). A biopsy was done by one of the writers (J. A. W.) on Oct. 28, 1941. The operative note emphasized the presence of a highly vascular and cellular tumor infiltrating surrounding muscles.

The reports of several pathologists were somewhat contradictory and confusing. Ewing's tumor and myeloma were considered (Fig. 3). The preferred diagnosis was myeloma. X-ray studies of the thoracic cage, lumbar spine, pelvis, and upper third of the lower extremities were negative at this time, apart from the right pelvic and left pubic bones.

On Oct. 31, 1941, the first series of x-ray treatments was begun. After 150 r/skin dose, a severe reaction occurred, with chills and fever of 103° F. We continued the treatment, nevertheless, every other day, though, because of the unpleasant reactions, mostly 80–100 r/skin were given. The rise in temperature following irradiation usually reached its peak three to four hours after treatment. No evidence of infection of the biopsy wound or other explanation for the increased temperature could be found. Furthermore, it was limited to two to five hours following irradiation. No anorexia, nausea, headache, or skin eruption was noted.

We succeeded in giving 15 treatments, totaling 1,700 r/skin through three portals. The physical factors were: 220 kv.; 20 × 20 cm. field; 50–70 cm. target-skin distance; Thoraeus filter; H.V.L. 2.0 mm. Cu; rate about 10–15 r/min. The depth dose at 50 cm. T.S.D., at 11 cm. depth, was about 42 per cent. Some improvement was noticed at the end of the series. The patient gained weight, her appetite improved, and the pain in the right hip practically disappeared.

On Dec. 8, 1941, a blood count showed 2,830,000 red cells with 58 per cent hemoglobin, 9,200 white cells with 71 per cent polymorphonuclears, 3 per cent eosinophils, and 26 per cent lymphocytes.

On Dec. 29, 1941, ten days after the completion of the first series, an x-ray examination of the pelvis showed no evidence of change.

Another series of x-ray treatments was begun on Feb. 9, 1942. Since the same reaction was encountered as in the first series, only 100–150 r/skin were given every other day. The patient received 13 treatments, totaling 1,700 r/skin with noticeable improvement.

Roentgenographic re-examination of the pelvis on April 11, 1942, revealed a considerable trabecular recalcification at the site of the previous destruction. The entire lesion, including the soft tissue swelling, appeared to be reduced in size.

The patient was now discharged from the hospital. She gained about 15 lb., still used crutches, but was fairly active. One day, for example, she rode with her son to a neighboring city about 80 miles distant. She refused further treatment because of the "feverish reactions." The blood count at this time was 3,530,000 red cells with 75 per cent hemoglobin, 4,800 white cells, with 80 per cent polymorphonuclears, 7 per cent eosinophils, and 13 per cent lymphocytes. The sedimentation rate was 45 mm. per hour (Wintrobe) and tests for Bence-Jones protein were negative.

On June 9, 1942, the patient was readmitted to the hospital with severe pain in the chest. X-ray examination of the pelvis at this time showed further

improvement (Fig. 4). Roentgenograms of the chest revealed numerous osteolytic lesions in the ribs, with two healing pathological fractures.

After this last admission, the patient's condition became worse rather rapidly. She complained mainly of pain in the chest and back, accompanied by dyspnea. There was no headache.

On June 10, 1942, the urine showed a moderate trace of albumin, many blood cells, and 20–40 pus cells per high power field. The red cell count was 3,370,000, with 74 per cent hemoglobin; the white cell count was 10,200, with 87 per cent polymorphonuclears and 1 per cent eosinophils. Blood studies on Oct. 17, 1942, showed serum total protein 10.1 per cent, with 5.3 per cent albumin and 4.8 per cent globulin. A formol-gel test was strongly positive. On Oct. 24, 1942, urinalysis revealed a one-plus Bence-Jones proteinuria.

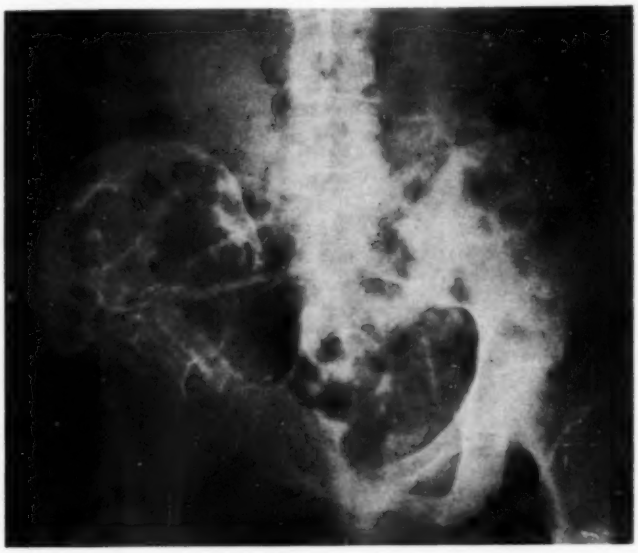

Fig. 4. Roentgenogram of the pelvis, June 9, 1942. Note the trabecular recalcification in the place of previous destruction. The entire lesion, including the soft-tissue swelling, is reduced in size.

The patient died on Oct. 28, 1942, three years after the first x-ray study and six years after the first appearance of symptoms in the right hip region.

On postmortem examination of the emaciated body the skeletal system, especially the ribs, the right side of the pelvis, and the skull (x-ray), showed the most extensive lesions. Multiple costal involvement was present, with pathological fractures of the right fourth and eighth and left sixth and seventh ribs.

Histologic examination of the irradiated area (tumor of right pelvic bones) revealed the presence of regular bone as well as osteoid tissue. The marrow spaces were fibrotic in most areas, with occasional remnants of tumor cell collections. These tumor remnants, as well as the tumor-infiltrated areas in the ribs, showed a very cellular neoplasm with a scanty fibrous stroma. The tumor cells were fairly large, polygonal or round, with the nuclei occasionally located eccentrically. The nuclei contained from one to three nucleoli and occasionally showed a somewhat spoke-like arrangement of the chromatin. The cytoplasm was ample but did not appear to be granular. The pathological diagnosis (Dr. Leo Moss) was plasma-cell myeloma (multiple).

As an interesting feature of the autopsy, small collections of tumor cells were found in the spleen. The patient also had a bilateral patchy bronchopneumonia. The kidneys showed only mild arteriosclerotic changes. An x-ray examination of the skull revealed numerous small osteolytic lesions, fairly characteristic of multiple myeloma (Fig. 5).

COMMENT

Upon reviewing this case, as well as the literature on the subject, it becomes evident that there are considerable difficulties in the roentgen diagnosis of these at least temporarily solitary myelomas. They are most commonly confused with *giant-cell tumors*. Pohle believes that the age of the patient, location of the tumor, the evidence of cortical destruction, and the somewhat

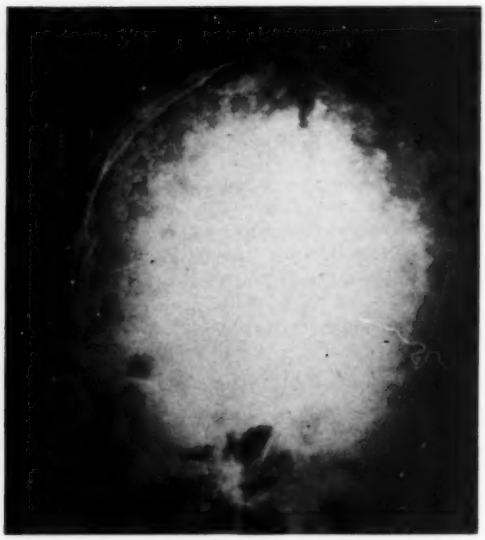

Fig. 5. Roentgenogram of the skull (postmortem), Oct. 28, 1942, showing numerous small occasional confluent osteolytic lesions, fairly characteristic of multiple myeloma.

coarser trabeculation may help in the differentiation.

These seemingly solitary myelomas usually occur around the age of fifty, are more often found in males, and are located most frequently in the spine, pelvis, and femur. They often infiltrate adjacent soft tissues, as in the case recorded here. The two tiny round areas of destruction in the pelvis were of great value in the differential diagnosis. As another important feature, the partial destruction of the opposite pubic bone in this case, through the symphysis, also deserves emphasis. In vertebral involvement a similar extension of myeloma —sometimes of Hodgkin's granuloma (Dresser)—occasionally occurs across the intervertebral disk. Malignant disease, however, does not as a rule traverse joint spaces. According to Camp and Dresser, the tumor, giving the appearance of having gone through the joint, actually extends around it by way of contiguous osseous or soft tissue structures demonstrable in postmortem specimens. Apparently this sign may sometimes occur in myelomas of extravertebral location also, as in this case, and is worthy of consideration in the differential diagnosis.

Osteogenic sarcoma, especially the *osteolytic* form and the so-called *chondroblastic* type (Geschickter), sometimes closely resembles the myeloma of this case. There are, however, fairly definite signs of distinction. These bone sarcomas practically always present a definite periosteal reaction, usually occur in patients under twenty, and are rarely found in the pelvic bones; their duration is seldom more than two years. *Localized fibrocystic disease of bone* is in general characterized by an earlier age incidence, comparative lack of symptoms, and a tendency to diaphyseal location in long bones. Certain types of *lymphoblastomas* and *hemangiomas of bone* may sometimes present similar roentgenographic features. Perhaps an especially important neoplasm in the problem of differential diagnosis is *Ewing's tumor*. The two conditions may appear identical, not only roentgenologically but even clinically (Liebman and Goldman, Swenson and Stout).

In conclusion, we agree with Paul and Pohle that, "at the present time, it is not possible to make an unequivocal diagnosis of solitary myeloma from roentgenologic examination alone, although the probability of its existence may be correctly stated." Biopsy and marrow puncture, together with blood studies and repeated urinalyses, should be done in all the suspected cases to establish the correct diagnosis as well as to determine possible generalization.

Regarding the result *of x-ray treatment*, we believe that the lesion in our case was probably quite radiosensitive, in view of the changes in the tumor area within a comparatively short time and the severe post-irradiation reactions. On the other hand, the degree of malignancy was probably low, considering the slow progress of the primary lesion. The great improvement in the patient's general condition, the pronounced change in the blood picture from 2,650,000 red cells with 51 per cent Hb. to 3,530,000 red cells with 75 per cent

Hb., as well as the rapid regeneration of bone in the area of destruction in a period of five months, make us wonder about the possible beneficial action of irradiation had it been instituted at the first discovery of the disease, in October 1939.

Finally, a few comments concerning the reaction, with chills and high temperature, after comparatively small doses of x-ray may be added. So far as we are aware no similar reactions have been mentioned in connection with irradiated solitary myeloma. Such systemic changes have been reported, however, in cases of leukemia, cellular carcinoma, mycosis fungoides, etc., by Engel, Holzknecht, Kienböck, MacKee, and others. In most instances the high temperature, with or without skin eruption, followed intensive irradiation and was believed to be a sign of toxemia as "a result of destruction of cellular elements, with the absorption of foreign proteins or biochemical products to which the organism reacts" (MacKee). Holzknecht speaks of four cases with intermittent fever and with a definite dermatitis where he noticed relatively insignificant subjective signs. He believed that this symptom-complex was of toxic nature and that it had a good prognosis.

In the absence of other noticeable subjective changes, and considering the comparatively good result of the irradiation in our case, it is felt that in spite of these systemic reactions similar cases should be treated by roentgen radiation with small fractionated doses.

The study of Bence-Jones proteinuria after these effective x-ray reactions might have been an interesting one.

SUMMARY

A case is presented of an apparently solitary myeloma originating in the right pubic bone with subsequent generalization. The difficulties of roentgen differential diagnosis and the favorable influence of roentgen irradiation are discussed.

Attention is called to the severe reaction—chills and high temperature—following comparatively small doses of x-ray treatment.

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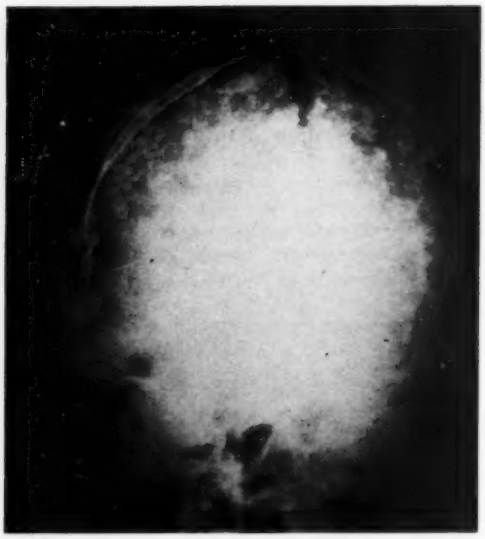

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Recovery of Radium Tubes from Sewer[1]

MARVIN M. D. WILLIAMS, Ph.D.

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Mayo Foundation, Rochester, Minnesota

A SEARCH FOR THREE tubes of radium which had been lost in a sewer, and the recovery of the last of these tubes fifty-four days after it disappeared, involved the use and consideration for use of some equipment which it is believed had not previously been employed for such work. The successful conclusion of this search was due to the suggestions and cooperation received from the hospital authorities, employees of the city engineer's department, members of the biophysics laboratory section, representatives of the insurance company, Prof. J. W. Buchta of the University of Minnesota, and numerous others whom we may have inconvenienced.

The tubes each contained approximately 50 mg. of radium, sealed inside a glass tube, which in turn was sealed inside a tube of Monel metal whose outside dimensions were 27 mm. (1 1/16 inches) in length and 5.6 mm. (a little less than 1/4 inch) in diameter, with a wall thickness of 1.5 mm. At the time the tubes were lost, each was tied in a separate finger cot and had small pieces of gauze bandage adhering to it because of clotted blood. When they were recovered, the finger cots were still attached to the tubes: one cot was still intact, one was slit part way down the side, and one was attached to the tube only by the string; all the gauze had been washed away.

The tubes were removed from a patient about 8:30 P.M. on Sept. 3 and presumably left in a tray, which also contained some instruments and dressings. That the radium was lost was discovered about 9:30 P.M. In the intervening hour the tray had been taken from the patient's room to a utility room, the instruments had been cleaned, and the hopper had been flushed.

A few minutes after 10 P.M. a search was started with a portable Geiger-Müller counter. As no indication of the radium was found on the floor of the hospital on which the loss had occurred, a rough check of the sewer line was immediately made from the utility room to its point of emergence from the hospital. Tests with a similar tube of radium made at a later date showed that the counter would have indicated the presence of any one of the three tubes if it had been in the hospital sewer line at that time. The wastepaper rooms, the linen rooms, and the incinerator were then checked. All wastepaper and linens were ordered held on the hospital floor until checked with the counter. By that time the hospital superintendent and engineer had arrived, and the sewer line in the hospital was again checked more carefully. The incinerator and the wastepaper and linen rooms were rechecked, and the search was carried through the rest of the hospital. The next morning the hospital, incinerator, linen and wastepaper rooms, and garbage were carefully checked, as were the manholes in the sewer line for a mile from the hospital, the sewage disposal plant, the laundry to which the hospital linens are sent, the laundry truck, the sewer line in the hospital, and roofs below the hospital windows. During the next few days the sewage disposal plant, the city dump grounds, the manholes in the first few blocks of the sewer line leading from the hospital, all wastepaper, and the incinerator were checked several times.

The sewer line for the first mile from the hospital is a tile pipe 12 inches (30.5 cm.) in diameter and 10 to 12 feet (3 to 3.6 meters) below the street surface. The line has a drop of 3 1/4 inches in 100 feet (27 cm. in 100 meters; 0.27 per cent grade) and at times runs two-thirds full of water. About 1 mile (1.6 kilometers) from the

[1] Accepted for publication in April 1943.

hospital this line connects with a larger line, and about 1 mile (1.6 kilometers) farther on this joins all the lines from the city and the sewage is carried under a river by means of two siphons. The bottom of the siphons is about 16 feet (5 meters) lower than the sewer line on either side of the river. The disposal plant is about 1/2 mile (0.8 kilometer) from the river.

Ten feet (3 meters) of earth is sufficient to make it impracticable to attempt to locate from the street radium which might be in the sewer pipe. Five or six feet (1.5 or 1.8 meters) of water would also make the use of the Geiger-Müller counter impractical, and there were places in the disposal plant and in some of the manholes near the plant where the depth of water was greater than this.

On Sept. 10, Prof. J. W. Buchta, of the Physics Department of the University of Minnesota, brought additional Geiger-Müller counters and helped with the search. The portable counter tube was covered with a rubber stocking so that it could be lowered about 3 feet (1 meter) into water. The disposal plant, city dump, sewer manholes, the entire hospital, incinerators, linen and wastepaper rooms, and the laundry were again carefully checked, and because of the bare possibility that the tubes might have dropped into someone's pocket or become attached in some manner to someone's clothing, the homes of the physician and nurses and of the patient's wife were checked. A few days later the city hog farm, to which garbage from the hospital is hauled, was gone over carefully.

It seemed most probable that the tubes had got into the sewer and that they might be carried along as far as the siphon under the river, but it did not seem probable that they would be carried up the incline of the siphon to the other side. Mr. Arleigh C. Smith, the city engineer, said that it would be possible to block off one siphon at a time, pump the water out, and then have a man carry a counter through the siphon. Before arrangements for doing this were completed, Mr. Smith came to the conclusion that the tubes would very probably be caught on some of the numerous projections or rough spots which undoubtedly occurred at each joint of the sewer pipes, and that they probably were lodged somewhere quite near the hospital. He suggested that he build a scraper (Fig. 1) which could be dragged through the sewer line between manholes and that this be tried in the first few blocks to see if the tubes could be brought into a manhole. This procedure was finally decided upon.

Fig. 1. Sewer scrapers designed by Mr. Arleigh C. Smith with 11-inch (28 cm.) (upper) and 9-inch (23 cm.) (lower) disks. The rod with rings on each end is free to move inside the pipe. Cables are attached to each ring. When the scraper is being pulled by the cable attached to the ring at the right, the upper half of each disk is held perpendicular to the pipe. If the scraper becomes stuck, or for any reason must be pulled back against the stream of water, it can be pulled backwards by the cable attached to the ring at the left, which collapses the upper half of the disks and allows the water to flow past the scraper.

At all times while a scraper, or other object, was being pulled through a section of sewer, the Geiger-Müller tube was suspended in the downstream manhole to detect the approach of a radium tube, and a fine-mesh screen was at all times kept ready to be placed over the outflow opening in the manhole to prevent a tube from being washed into the next section of sewer. Two days were spent in unsuccessful efforts to get the 11-inch (28-cm.) scraper through the block of sewer in front of the hospital, although a wadded-up truck tire chain was pulled through. It was finally decided to build another manhole in the center of the block and to construct a 9-inch (23-cm.) scraper.

While these were in course of construction, work was carried on in the next block of sewer. On the first attempt to pull the 11-inch (28-cm.) scraper through, it became stuck and had to be pulled back. The wadded-up truck tire chain was then pulled through and one of the radium tubes came out with the chain; on the next attempt, the 11-inch (28 cm.) scraper was pulled through and the second radium tube was pushed ahead of the scraper. This was on Oct. 15, just six weeks after the tubes had been lost. Both the scraper and the tire chain were pulled through this and the next three blocks of sewer several times, but the third tube was not located.

Since it was possible that the tube might be lodged in a crevice, where it would not be dislodged by anything pulled through the sewer, further blind dragging seemed rather a waste of time. It was decided, therefore, to try to determine definitely whether or not the tube was in a given section of sewer before attempting to clean it. We had considered earlier the possibility of attaching long leads to the Geiger-Müller tube and pulling it through the sewer, but the shortage of suitable shielded cables made that procedure impracticable during war times. Mr. Adrien Porter, one of our mechanics, had suggested putting one of the chambers of the Victoreen minometer in a water-tight housing and pulling that through the sewers, but the minometer did not seem to me to be quite sensitive enough (its sensitivity will be discussed later). Dr. Robert B. Taft (3) had suggested attaching dental films to a cable and allowing them to remain in the sewer long enough to give a definite indication of the presence or absence of the radium. As this seemed to be feasible, tests were made in the laboratory to determine the necessary spacing and exposure time in order to obtain positive results.

The first problem to be solved in order to use the films was their protection from water. Finger cots were considered, but were abandoned because of the scarcity of rubber. The City Engineer's Department had steel rods, 1/4 inch (6.35 mm.) in diameter, which are used to push cutters through the sewers, and it was thought that it might be possible to wrap the films around these rods and cover them with a waterproof covering. For the laboratory tests a tube 30 inches (76 cm.) long and 2 inches (5 cm.) in diameter was filled with water and a tube containing 50 mg. of radium was placed in the bottom. Dental films were wrapped around a piece of glass tubing and covered with two layers of waterproof adhesive tape with a layer of electrician's friction tape between. After twenty-four hours' immersion in water the films were still dry. The tests showed that with Eastman Radia-Tized dental film a spacing of not more than 2 feet (61 cm.) between film, and with Eastman Super Speed Occlusal film a spacing of not more than 4 feet (1.2 meters) between film, with an exposure of twenty-four hours, would be necessary in order to make sure of detecting the tube of radium. The time involved in attaching the film, allowing for the twenty-four hours' exposure, removing, developing, and inspecting the film, seemed rather long should it prove necessary to inspect 2 miles (3.2 kilometers) of sewer. Also, should one film be damaged, that section of sewer would have to be rechecked. Our next idea was to obtain 8-mm. motion picture film, thread it inside ordinary garden hose in a darkroom, plug the ends of the hose, and draw the hose into the sewers. Since with this method the radium tube could not be more than a few inches from the film, a much shorter exposure time could be used.

Before we got around to testing the film-in-hose idea, Mr. Jacobs, one of our mechanics, who had been alternating with me in operating the Geiger-Müller counter, suggested using our Lauritsen electrometer (1). A piece of iron pipe (Fig. 2), 2 1/2 inches (6.35 cm.) inside diameter and 12 inches (30.5 cm.) long, was fitted with a cap at each end. A short piece of 3/4-inch (19-mm.) pipe was welded onto each cap for attaching cables or the steel rods so that the assembly could be pulled or pushed through the sewers. The

electrometer was put inside a piece of rubber stocking to protect it from moisture in case one of the caps on the pipe did not fit tightly, a piece of felt was wrapped around it to make it fit snugly inside the pipe, and disks of sponge rubber placed at either end and a strip of sponge rubber wrapped around the microscope tube were used to help absorb mechanical shocks.

Fig. 2. Portable Geiger-Müller counter (top), with chamber and part of cable covered with a rubber stocking for immersion in water, and extension cable for headphones so that chamber and control box could be lowered into sewer manholes. Lauritsen electrometer (lower right), iron pipe with caps in which electrometer was pulled through sewers, and material used for packing electrometer inside pipe.

Dragging the pipe with the electrometer inside over the laboratory floor for half an hour discharged the electrometer about two divisions (full scale was 100 divisions); dragging it, at a rate of 6 feet (1.8 meters) a minute, past a tube containing 50 mg. of radium shielded by a minimum of 4 inches (10 cm.) of water and with a minimum distance of 10 inches (25 cm.) between radium and electrometer, produced a full scale discharge. This indicated that dragging the electrometer through the sewer at a rate of not more than 10 feet (3 meters) a minute should prove quite definitely whether or not the lost tube of radium was in a given section.

Similar tests made with the 0.01 r chamber of the Victoreen minometer showed that it was only about a fifteenth as sensitive as the electrometer, and hence to prove the presence or absence of the radium it probably should be pulled at a rate of not more than 1 foot (30 cm.) a minute.

The first actual use of the electrometer was to test the sewer line from the hospital to the street. No indication of the radium was found. As the line from the hospital apparently joined two sewer lines in the street and these two lines were connected with each other in the middle of the block, the first half block of each of these lines and the line connecting them were next tested. In none of these tests did the electrometer

show a greater discharge than would be expected because of the natural leak of the instrument. The first trip through the next half block of sewer completely discharged the electrometer. Further tests showed that when it was pushed in a distance of 24 feet (7.3 meters) from the farther manhole there was no discharge, but when it went in a distance of 30 feet (9.1 meters) there was a complete discharge. As intermediate distances were not tried, it is not known how accurately the position of the tube of radium could have been determined.

The 11-inch (28 cm.) scraper could be pulled through this section of sewer only to the approximate location of the tube of radium. Beginning at this point there was a deposit, which looked like coal dust, about 2 inches (5 cm.) thick in the bottom of the sewer, which had caught the third tube of radium, although the other two tubes had passed over it. The deposit was packed too tightly to be cleaned out with the larger scraper. After the tire chain and the 9-inch (23 cm.) scraper had been dragged through several times, removing part of the deposit, the 11 inch (28 cm.) scraper was finally pulled through and the tube of radium came with it. This was on Oct. 27, fifty-four days after the tube had been lost.

Electroscopes and Geiger-Müller counters have been used by several searchers in the past to locate radium in sewer lines but, as far as is known, this is the first time such an instrument has been pulled through a sewer. If a sewer is located near the surface of a street, or in a tunnel through which one can carry instruments, the search may be mostly a matter of time. However, as pointed out by Taft (2), the material between the instrument and the radium is of great importance. One foot (30 cm.) of water is equivalent to about 1 inch (2.5 cm.) of lead, 1 foot of earth to about 1 1/2 inches (3.8 cm.) of lead, and 1 foot of concrete to about 2 inches (5 cm.) of lead, and each half inch (1.3 cm.) of lead reduces the intensity of the gamma radiation by about 50 per cent. If a quantity of radium similar to that which has been lost is available, it may be very worth while to put it in some of the places where the lost radium might be and see if the instruments being used will detect its presence. The shielding power of walls or floors may be surprisingly great.

It is possible that in the search described here the counter might have shown a count slightly higher than the background if held in the street directly over the radium. But to have tested even a block of sewer in this manner, in which the count would not have been increased by more than a few per cent, would have been a tedious and time-consuming job; either of the film methods or the use of a minometer chamber would have been quicker, less time-consuming, and more certain. The film method suggested by Taft or the use of motion picture film in a hose should give satisfactory results and, for testing short lengths of sewer, might be the quickest method, since all the necessary materials would probably be readily available. The spacing of small films and the necessary time of exposure would depend on the amount of radium being looked for; these factors might best be determined by preliminary laboratory tests. The only advantage of an electrometer, such as was used in this search, over a minometer chamber is that the dragging speed for the electrometer can be much greater than for the minometer. A minometer, however, might be more readily available in a radiologic department than a suitable electrometer. Again, when any instrument of this type is used, one should first make preliminary tests, using a quantity of radium similar to that being sought, to determine the maximal speed at which the instrument can be moved.

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X-Ray Therapy in the Army[1]

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X-RAY THERAPY in the Army, as a unit, is a problem beyond an individual's limits for discussion. Because of the rapid changes taking place in Army organization, and the unforeseen circumstances that may arise, one is not in a position today to discuss the single field of any medical department. We are in a stage of streamlining, brought about by a new type of warfare, the world-wide dissemination of power, the wide range of battles, and the depth of front line defense. This increases the problems of medical care, of the transportation of patients, and the more rapid and better treatment of casualties.

Because of difficulties encountered in obtaining statistical data on new developments, and the limitations inherent in a discussion of what may take place in the future, it is far better to describe what the situation has been and what we may care to strive for in the future. For these reasons this presentation will outline what is taking place at one of a number of General Hospitals in the Army and the interest of the Army in affording its personnel adequate radiation therapy.

The rapid expansion of the standing Army of a few years ago, of several hundred thousand men, to that of today, numbering 5 to 10 million, requires changes in all departments and facilities for more extensive medical care. Many new hospitals have been established, not all of which, however, are as completely equipped as others. This is because the primary concern of the complements of the Army in war is traumatic surgery and general medicine. Cases requiring special care are transferred to General Hospitals strategically placed throughout the United States.

X-ray therapy is practised to some extent throughout the whole Army Medical Department, regardless of where the components may be located. In the field of combat, however, it is not generally encountered, as there the treatment of conditions requiring prolonged hospitalization is not to be expected.

The x-ray machine now designed for use in the zone of combat, and where fixed installations are not possible, is a portable roentgenographic unit which may be used also for superficial x-ray therapy, as for infections and dermatoses. Some of the infections which may be encountered in combat zones are gas gangrene, aerobic cellulitis, including erysipelas, subcutaneous abscesses, carbuncles, furuncles, lymphogranuloma venereum, lymphangitis and lymphadenitis. Dermatoses which might be considered for x-radiation therapy include acute folliculitis, pyogenic or mycotic sycosis, acute dermatomycosis, acute eczemas characterized by intolerable pruritus, and herpes. It is not reasonable to assume that superficial neoplasms should be treated in the field, although such treatment could be given if no other facilities were available.

The large majority of cases requiring x-ray therapy reach the General Hospitals, where there is every facility for proper treatment, where most of the modern conveniences for the patient's comfort are available, and where the length of hospitalization depends upon the progress of the case. Here are seen the cases comparable to those observed in clinics and offices, and the problems are those of the surgeons, the medical men, dermatologists, and other specialists. At the writing of this paper there are seven Army General Hospitals within the continental United States and two outside the United States, in which both deep and superficial x-ray

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therapy are available: Letterman General Hospital, William Beaumont General Hospital, Gorgas General Hospital, Tripler General Hospital, Brooke General Hospital, Fitzsimmons General Hospital, Army and Navy General Hospital, Lawson General Hospital, and Walter Reed General Hospital. Radium, too, is available at Letterman General Hospital, Army and Navy General Hospital, Gorgas General Hospital, and Walter Reed General Hospital. In addition, 1,000 mg. of radium, purchased years ago by Army funds, were entrusted to the Howard Kelly Institute, of Baltimore, with the understanding that Army personnel might be treated there.

At Lawson General Hospital, one of the later General Hospitals to include facilities for x-ray therapy, the service is divided into diagnostic and therapy departments, which are housed in adjoining buildings. Here there is apparatus for superficial therapy in the peak range of 140 kv. and deep therapy equipment with a capacity of 220 kv. The therapy department is housed in well lighted air-conditioned rooms. The office and superficial therapy room are combined, while the deep therapy and controls are in separate rooms. Inasmuch as the department was planned before the building of the hospital, it was our good fortune to have everything built according to the latest recommendations of the National Bureau of Standards and the International Roentgen Ray Committee on X-ray Protection. The department has also been supplied with adequate equipment and supplies necessary for treatments, and the various adaptors and cones for the machines. The measurement of the ionization output from the machine is checked at frequent intervals, and a Victoreen Constancy meter is employed during the course of the treatments as a check on proper filtration and operation of the machine.

The superficial therapy section has been in operation since the hospital was officially opened in July 1941, but the deep therapy installation was not completed until February 1942. Since July 1941 there have been 6,468 admissions to the hospital, including 316 cases for either deep or superficial treatment. A total of some 4,500 treatments[2] of one type or another have been given. The x-ray therapy department must, under the tables of organization, give all radiation administered in the hospital, and for this reason dermatological patients lead the list, constituting about 30 to 50 per cent of all those treated. The remainder of the cases are from the medical, surgical, nose and throat, genito-urinary, neurological, and plastic surgery sections. These remaining cases are chiefly the lymphomatous diseases (including Hodgkin's disease), bone tumors, neoplasms of kidney and testis, parotid tumors, and a few laryngeal, oral, and labial cancers. A few carcinomas and sarcomas of other types are observed from time to time, including melanosarcoma, rhabdomyosarcoma, intracranial tumors, reticulum-cell sarcoma, synovioma, Peyronie's disease, adamantinoma, as well as nonmalignant conditions such as arthritis and bursitis. It might be interesting to note the number of cases of leukemia and Hodgkin's disease seen, for although we are not in a position to make a definite statement, and no statistics are available, the impression is that we see more of these cases than are seen on the outside in the same age groups. There may be a fallacy in this observation, in that we obtain our cases from a wide range of concentrated camps and station hospitals, the complement number of which we are unable to determine and cannot estimate for several years hence. The question has arisen whether there is any relationship between exposure to the hardships of military service and the incidence of these diseases; also as to the part immunization against certain infections may have in producing a so-called "shock" to the hemopoietic system in certain individuals with a predisposition to the blood dyscrasias. This should bear further investigation and research, as also the relationship between trauma and bone tumors.

[2] Since this paper was read some 10,000 more treatments have been added to this number.

The great need for x-ray and radium therapy in the Army is evident if we review the statistics given in the last Annual Report of the Surgeon General (for the fiscal year ending June 1940). The surgeon of each military station or command renders a monthly report of the sick and wounded. From such reports the Surgeon General derived the information used as the basis of calculation of morbidity and mortality rates for the year 1939. In that year the Army numbered 191,551, and there were 81 cases of cancer, with 36 deaths, and 390 cases of non-malignant tumors. The annual admissions rate per 1,000 for officers and enlisted men was 0.4 for cancer and other malignant tumors, and 2.0 for non-malignant tumors. For cancer there was an average loss of 114.2 days per case, or a total of 9,252 days. In this same report the strength of the Army Nurse Corps was given as 684, with an incidence of 5.85 per 1,000 for cancer and other malignant tumors and of 7.31 per 1,000 for non-malignant tumors.

From these figures we may foresee the vast number of malignant neoplasms to be expected when the Army is expanded to 5 or even to 10 million, though the rate would probably no longer be the same, because of the wider range of ages and the methods of selection. In an Army of 5 million men we would expect between 2,000 to 3,000 cases of cancer and 9,000 to 10,000 cases of non-malignant tumors. Because of the close observation of patients in the Army, which is not possible in civilian practice, many cases are seen earlier, with the result that the disease is more frequently arrested and the men can return to duty.

Now for the first time the Army will have a complement of women about equal to our standing Army before our entry into the war. This additional strength will be made up of the Army Nurse Corps and the Women's Army Corps. Many cases of cancer in this branch of the service, especially those referable to the breast and genito-urinary tract, will fall to the care of the Medical Department of the Army. This may mean the addition of more x-ray therapy departments to certain General Hospitals; certainly it will mean an increase in the allotment and establishment of more centers for radium treatment.

Patients suffering from cancer and allied diseases, few as compared to battle casualties, must be cared for, and the problem of their treatment is primarily one that should interest the radiologist. Here, in an army of millions, can be practised the principles of "early recognition and early treatment."

A disease so prevalent as cancer, with a mortality rate surpassed by only one other condition, must be controlled. The part the radiologist plays, whether in the Army or civilian practice, has much to do in this control; for no matter how meager the contribution, the concerted efforts will eventually produce results.

Lawson General Hospital
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CASE REPORTS

Roentgen Evidence Suggesting Entero-colitis Associated with Prolonged Cathartic Abuse[1]

NORMAN HEILBRUN, M.D.[2]

Buffalo, N. Y.

The following case is reported because of the extensive changes in the lower part of the small bowel and throughout the large bowel observed in routine gastro-intestinal studies. As far as can be determined, the etiological factor was the continued and abundant daily use of irritant cathartics for twenty years prior to the roentgenological examinations. A search of the literature has failed to reveal any other case presenting similar changes, although reference is made to catarrhal colitis resulting from overdosage or continued cathartic abuse from irritants (1, 2).

CASE REPORT

The patient was a multiparous white female, thirty-six years of age, who for many years had complained of bloating and a feeling of general fullness in the abdomen. She believed that she could not be comfortable without complete evacuation every day. To insure this she had taken proprietary cathartic tablets, the active ingredients of which are phenolphthalein, aloin, and podophyllum, almost daily for the preceding twenty years, *i.e.*, from the age of sixteen until December 1940. This resulted in from two to three watery stools daily, generally in quick succession, producing a feeling of well-being in the abdomen and a sense of complete emptying of the bowels. There had never been involuntary diarrhea. The stools contained mucus at times, but pus and blood were never observed. Unless cathartics were taken the patient experienced constipation, and she never allowed herself to go without an evacuation for more than forty-eight hours without resorting to their use.

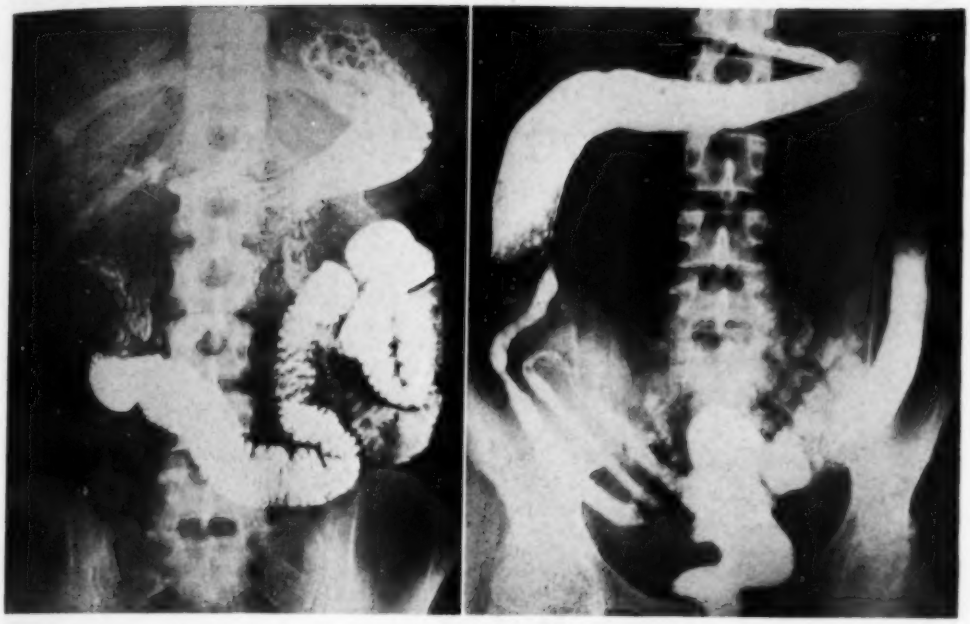
In July 1932, the patient had an attack of cramp-like pain in the right lower quadrant lasting for several days, which her attending physician thought was possibly due to appendicitis. An abdominal exploration revealed thickening of the terminal ileum and cecum up to the junction of the cecum and ascending colon. Here a constricting band was found, which was separated. The appendix was removed and microscopic examination showed subacute appendicitis. There was no evidence of specific or non-specific granuloma. No biopsy specimen was taken from the thickened bowel but the surgeon and those who subsequently observed the case felt that a hyperplastic tuberculous process was probably present.

During the entire twenty-year period there had been no persistent loss of weight, and the patient's general health and nutrition had been relatively good. Her general complaints did not vary to any extent. Because of fear that there might be some organic basis for them, a gastro-intestinal study was made on Nov. 18, 1938. The findings in the upper tract were fairly normal as far as the lower jejunum. The upper jejunum showed slight dilatation (Fig. 1). There was delay in passage of contents through the lower ileum, as it took five hours and a half for the head of the test meal to reach the cecum. The appearance of the terminal ileum and large bowel at seven hours is shown in Figure 2. The mucosal pattern in the terminal ileum is entirely gone and it has a rigid, tube-like appearance. On palpation, the terminal ileum and cecum could be moved about without causing pain. No mass corresponding to their outline could be felt. The colon was narrowed, spastic, and completely lacking in haustrations, presenting a picture similar to that seen in severe colitis. There were no dilated loops of large or small bowel which could reasonably explain the symptoms of bloating and fullness. It is to be noted that the shortening at the flexures and in the sigmoid region is not quite as great as is usually seen with this degree of involvement from a true colitis. Figures 3A and 3B were obtained following barium and air injections into the large bowel. The complete lack of haustrations is striking, but more important is the degree of distensibility, which precludes the possibility of organic thickening of the musculature of the bowel wall from chronic inflammation. The air study shows the mosaic appearance of the mucosa resulting from edema. It would seem, from the history, that the roentgen findings of entero-colitis were the result of excessive catharsis rather than infection. The clinical findings were in close correlation. The patient was advised to discontinue the use of cathartics and a course of treatment was outlined for her.

A year later, in October 1939, another complete gastro-intestinal study was made and the findings were approximately the same as those illustrated. The patient had not altered her regimen in any way during this interval. A year after this she entered the Buffalo General Hospital for study and treatment, which lasted from Nov. 22 to Dec. 4, 1940. Her physical and nutritional states were good. The

[1] Accepted for publication in June 1943.

[2] Captain, Medical Corps, A.U.S., Chief of Roentgenological Service, England General Hospital, Atlantic City, N. J.



Figs. 1 and 2. First studies made on Nov. 18, 1938. Fig. 1 (left), taken at 1 hour, shows slight dilatation of the jejunum and widening of the folds. In Fig. 2 (right), taken at 7 hours, the lack of normal markings in the terminal ileum and the pipe stem appearance of the colon are well illustrated.

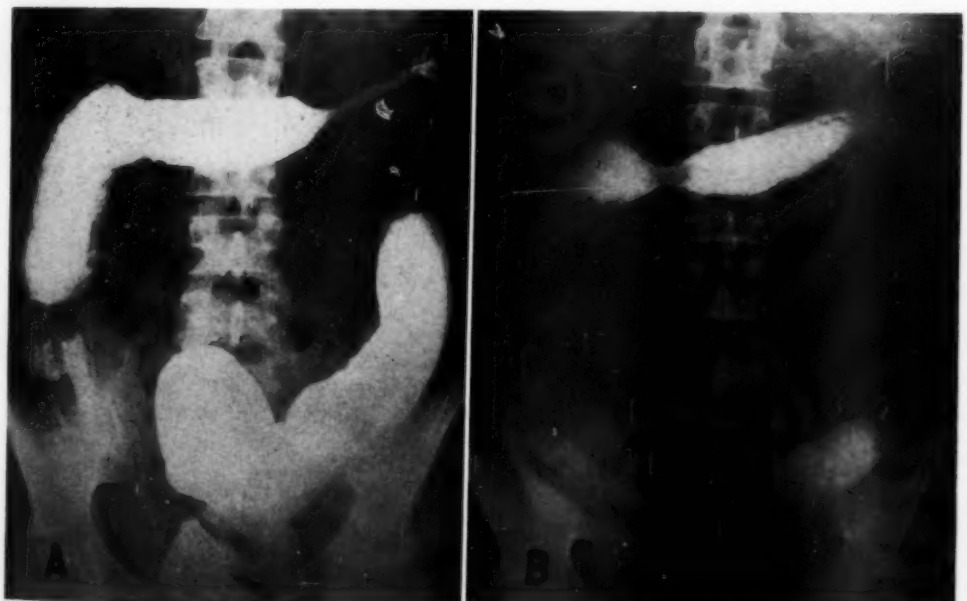
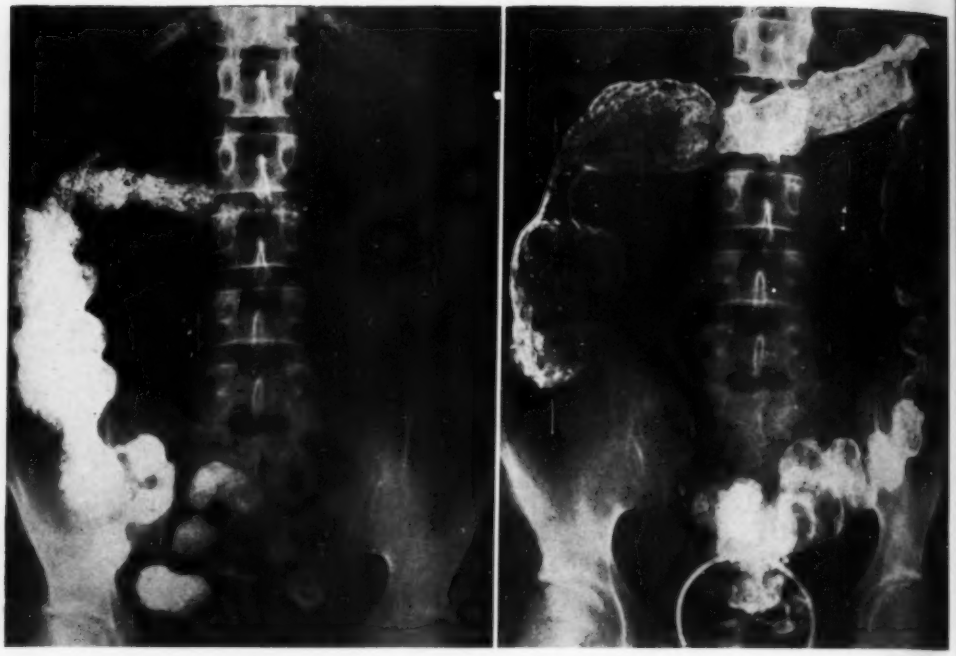


Fig. 3. Barium enema studies before and after air insufflation, Nov. 19, 1938. The lack of haustrations throughout the bowel (A) and the mosaic appearance of the cecum and descending colon (B) are seen, as well as the degree of distensibility present in both.



Figs. 4 and 5. Roentgenograms made in January 1941, approximately one month after cessation of all cathartics. Fig. 4(left) is a 10-hour study. The more normal segmentation of the terminal ileum and the haustrations in the ascending colon should be compared with Fig. 2. The haustral segmentation of the descending colon and lengthening of the sigmoid colon and splenic flexure are shown also in the 24-hour roentgenogram reproduced in Fig. 5 (right).

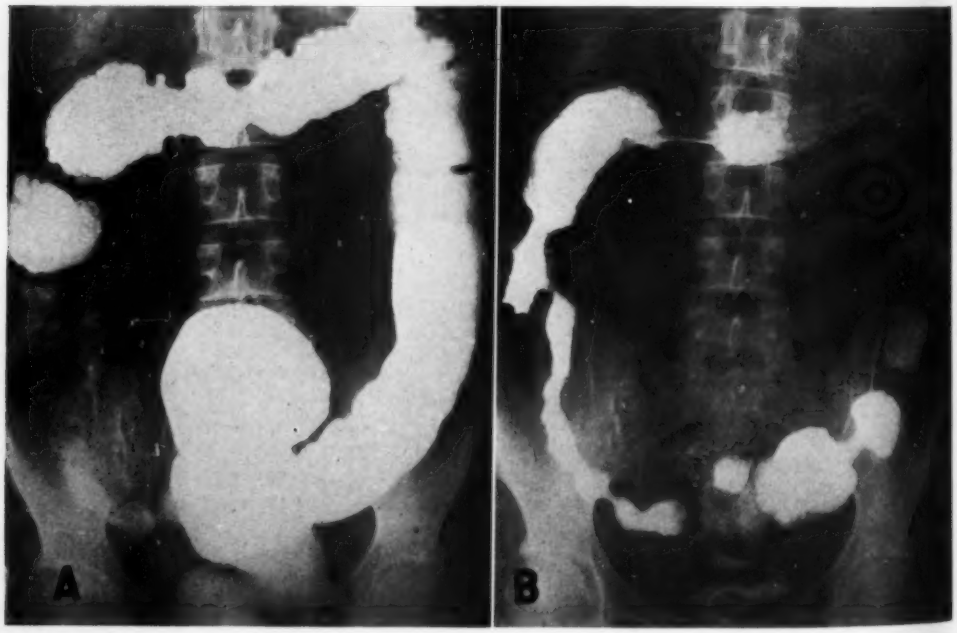


Fig. 6. Barium enema studies before and after evacuation, Jan. 6, 1941. The spasticity of the cecum and abnormality of the mucosal pattern of the descending colon are still present.

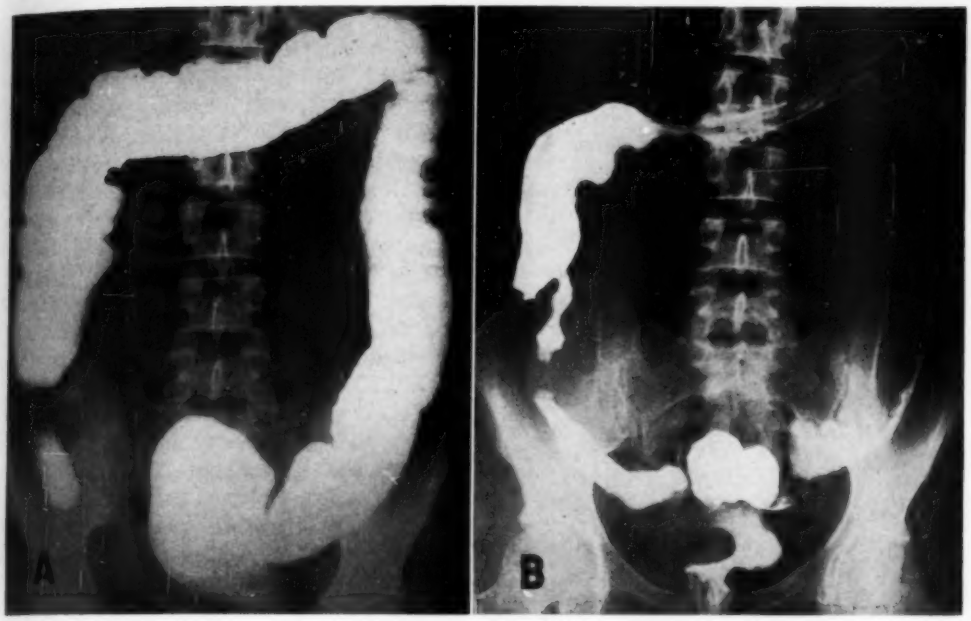


Fig. 7. Barium enema studies before and after evacuation, April 16, 1941, approximately five months after cessation of drastic catharsis. There is slight improvement, but the spasticity of the cecum is still apparent. The mucosal pattern of the descending colon also remains abnormal.

blood, urine, and stool examinations showed no abnormalities except for some increased mucus in the stools. Sigmoidoscopic examination revealed some edema and hyperemia of the mucosa but no evidence of scarring or fixation due to previous acute or chronic ulceration. Upon admission, all irritant cathartics were stopped and the patient immediately felt uncomfortable and distressed. Abdominal distention was marked and various measures for its relief were resorted to, such as enemas, hot stupes, mineral oil, and occasionally pituitrin. Nutritional requirements were well controlled with a smooth diet, added bulk, and vitamins. After a few days some evacuation became possible without accessory means. On discharge the patient was advised to use a suppository and, if this was not successful, to follow it with a plain warm water enema. Subjective symptoms of fullness and bloating continued but there was no noticeable distention.

Another complete study was made on Jan. 4, 1941, a month after discharge from the hospital. During this interval the patient had adhered to the prescribed regimen. There was still a considerable delay in the passage of barium through the ileum but its appearance had improved markedly. The head of the meal did not reach the cecum for seven hours. Figure 4, a ten-hour film, shows segmentation and slight dilatation of the terminal ileum; peristalsis was observed under the fluoroscope. Figure 5 is a 24-hour film showing haustrations in the distal half of the bowel with less shortening of the flexures than was previously noted. The barium clysma (Fig. 6A) showed haustrations throughout the colon, less marked in the proximal part. Fluoroscopically it was noted that the cecum filled out normally but had a tendency to be spastic and irritable. This is well illustrated in the post-evacuation film reproduced in Figure 6B.

The patient remained on the suggested regimen for two months but never obtained complete freedom from symptoms, even though the enema and suppositories produced fair evacuation. She never felt that her bowels were adequately emptied. Accordingly, she began to take, from two to three times a week, a bulk proprietary preparation which contained an irritant cathartic, senna. Approximately two months later, on April 16, 1941, a colon study was made. The terminal ileum filled and presented about the same appearance as at the previous examination (Fig. 5). During the filling the large bowel, especially the proximal half, was moderately spastic but finally relaxed so that, in general, the appearance was thought to show slight improvement over the previous examinations. The continued irritability and spasticity were considered as probably due to the senna. Figures 7A and 7B are the enema and post-evacuation studies, respectively.

The patient's general condition has remained unchanged up to the present time. Since July 1941, she has been taking a tablet containing aloin, ex-

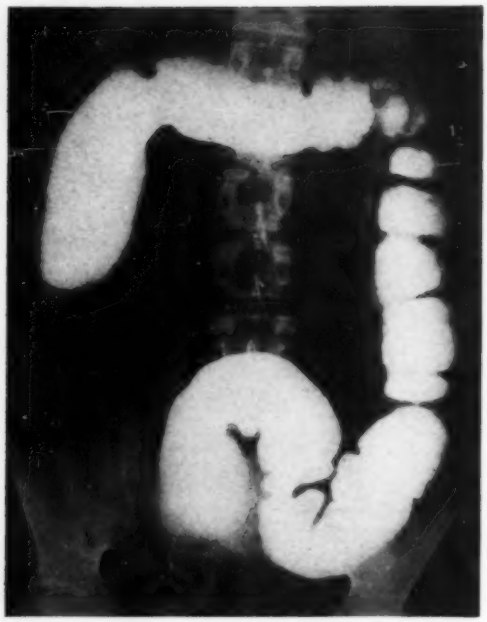


Fig. 8. Barium enema study made on Nov. 1, 1941, approximately eleven and a half months after the cessation of drastic catharsis. The distal half of the colon presents a more normal appearance.

tract cascara, and podophyllum, from one to two times a week, and is fairly comfortable. She states that omission of the cathartic results in discomfort. Another complete examination, both orthograde and retrograde, was carried out on Nov. 1, 1941. There was still delay in passage of the test meal through the small bowel, as it took from seven to eight hours for the head of the meal to reach the cecum. The appearance of the ileum was approximately the same as in the previous examination, Jan. 4, 1941. However, the haustrations of the distal half of the colon from the splenic flexure to the rectum, as shown by clysma, appear to be more nearly normal than at any previous time (Fig. 8).

DISCUSSION

In view of the rather good clinical state of the patient over the period of years during which extensive changes were revealed by the gastro-intestinal studies, it seemed probable that these changes were due to the excessive catharsis rather than to inflammatory changes in the bowel wall resulting from an infectious agent. All of the clinical and laboratory observations seemed to support this idea. The only adequate proof available, however, was the therapeutic test of stopping all cathartics over a period of time. Shortly after their discontinuance the patient became very much more uncomfortable, which would seem to substantiate the conclusion reached. Much more significant, however, was the improvement in the intestinal pattern shown in roentgen studies made approximately one month later (Jan. 4, 1941). It is interesting to note that, although the pattern showed improvement, the transit time of the barium through the small intestine did not return to normal. This delay may perhaps explain the good nutritional state of the patient over a period of many years, in spite of the pronounced changes in the mucosal pattern. There may have been interference with the absorptive function of the mucosa, but it is possible that this was compensated by the prolonged transit time.

The active ingredients of the proprietary preparation used so excessively were podophyllum, aloin, and phenolphthalein, which are classified as irritant cathartics (3). Podophyllum is the most irritant of the resinous cathartics and its action is chiefly on the small intestine. Aloin is a glucoside which on hydrolysis yields an anthraquinone derivative. It is the most irritating of the emodin cathartics, which act chiefly on the large intestine. The last drug, phenolphthalein, exerts its action mostly on the large intestine, but also increases the motility of the small intestine. In addition to its irritating action, it is said to stimulate directly the motor activity of the bowel. Thus the character of the cathartics used and their sites of action would seem adequate to explain the roentgen changes persistently found. The excessive irritation of the mucosa and the motor stimulation of the nerve endings could probably produce edema of the mucous membrane, excess activity of the mucous glands, slowing of the rate of passage through the small intestine, and spasm of the entire tract.

The symptoms of bloating and fullness were never adequately explained by the

roentgenographic findings, because at no time were any dilated loops of bowel seen, nor was there any distention observed clinically except shortly after discontinuance of cathartics. Brown (1) states that the continued use of physics sets up irritability of the bowel wall of two types. These are, first, catarrhal inflammation of the mucous membrane and, second, in the case of the aromatic (emodin) cathartics, irritability of the nerve elements in the bowel wall. Both these changes result in varying degrees of hypertonus and spasm of the muscular wall of the colon with varying degrees of discomfort or actual abdominal pain. When a segment of gut is clamped down in chronic spasm the sensory effect is the same as that caused by over-distention of a normal loop of bowel; hence there may be complaints of fullness, pressure and distention, without any physical evidence of distention. In the case recorded here both effects are probably present because cathartics of both types were used.

The question arises as to whether the failure of the intestinal pattern to return completely to normal between April and November 1941 is due to the presence of permanent irreversible changes in the bowel wall. It seems quite plausible that continuous irritation of the nerve endings and mucosa could bring about some edema and cellular infiltration of the tissues which, if continued over a long enough period of time, might produce permanent changes. Hyperemia and edema were observed proctoscopically. The patient is still using milder cathartics of the same general type, although less frequently. This may offer an additional explanation for the lack of further improvement.

SUMMARY

A case is presented in which extensive changes in the small and the large intestine were found in a patient who had used irritant cathartics continuously for twenty years. The roentgen appearance suggested ileitis and colitis. In the absence of the usual signs and symptoms of these diseases, it seems probable that the intestinal abnormalities were due to the cathartics, since there was rather noticeable improvement in the roentgen appearance shortly after the ingestion of these irritants was discontinued.

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Calcified Concretions within a Meckel's Diverticulum[1]

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Calcification in appendiceal concretions of sufficient density to produce a visible shadow on the roentgenogram has been described on several occasions. As early as 1908 Seelig (1) reported a case of appendicitis which resembled ureteral calculus because of the presence of a calcified appendiceal concretion in the course of the ureter. Since then Pfahler and Stamm (2), Douglas and LeWald (3), Shelley (4), and recently Jackman (5) have contributed further examples. In 1940 Grevillius (6) reported a case of intestinal calculus which had caused perforation of a Meckel's diverticulum. We have been unable, however, to find in current American literature any case in which the shadows visible on a roentgenogram were proved surgically to represent calcified concretions within a Meckel's diverticulum. Such a case is reported here.

CASE HISTORY

On Nov. 18, 1942, a 34-year-old white male was admitted to the Mary Hitchcock Memorial Hospital complaining of nausea and vomiting associated with abdominal pain. The symptoms had begun four days previously, with nausea immediately followed

[1] Accepted for publication in June 1943.

Fig. 1. Roentgenogram of the abdomen showing multiple distended loops of small bowel. In the right lower quadrant are the two irregular shadows of calcification.

by vomiting and a dull aching central abdominal pain. Since the onset the patient had retained nothing taken by mouth and the abdomen had become distended. In spite of multiple daily enemas there had been no bowel movements prior to admission to the hospital. There was no history of previous related symptoms. The patient's family history was non-contributory and his past history revealed nothing except a quite severe chronic rheumatoid arthritis.

The general appearance was that of a thin middle-aged man, acutely ill, holding himself rigidly as he lay in bed. Temperature, pulse, and respirations were within normal limits. Except for the rather severe arthritic deformities involving all the joints, the significant physical findings were abdominal. The abdomen was greatly distended and peristalsis was increased. There were no palpable masses, and rectal examination was negative.

The clinical impression at the time of admission was acute intestinal obstruction (volvulus?, adhesive band?); chronic rheumatoid arthritis.

The only significant laboratory findings were a white blood count rising from 7,200 at 8:45 A.M. to 10,000 at 2:00 P.M. on the day of admission and a slight elevation in the non-protein nitrogen (40 mg. per 100 c.c. whole blood). The latter is easily explained on the basis of the obvious dehydration.

A roentgenogram of the abdomen (Fig. 1) showed multiple distended loops of small bowel, without an abnormal amount of gas in the colon. A diagnosis of intestinal obstruction was made. In addition, two irregular areas of calcification were seen in the right lower abdomen. These were considered to be most likely calcified nodes, although they were somewhat lower than would be expected. The possibility of gallstones within the lower ileum was considered, but the character of calcification did not favor this diagnosis.

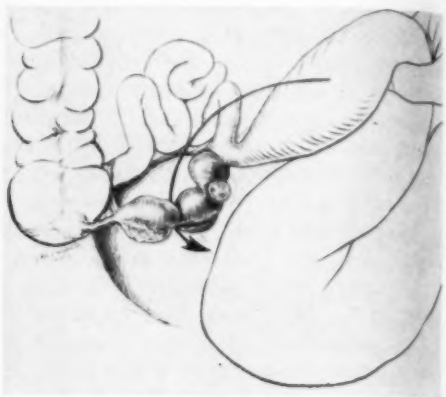

Fig. 2. Drawing demonstrating the mechanism which caused the intestinal obstruction, the Meckel's diverticulum and the appendix together forming a band behind which a loop of ileum just proximal to the diverticulum had become lodged and obstructed.

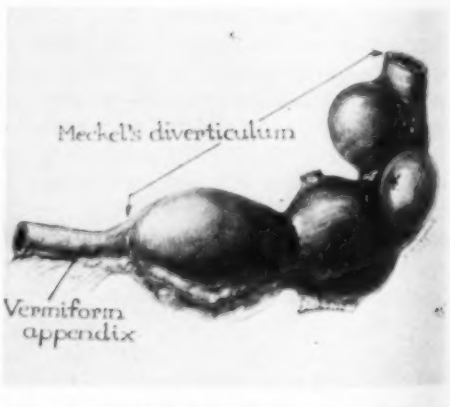

Fig. 3. Drawing of the gross specimen showing the Meckel's diverticulum attached to the tip of the appendix.

Soon after admission fluids were administered intravenously and a Miller-Abbott tube was introduced. In spite of repeated attempts, the tip of the tube failed to pass through the pylorus into the duodenum. At 8:15 P.M. on the day of admission, after observation and treatment had been in progress for twenty hours, it was decided to undertake an exploratory laparotomy. During this time the

patient had received 4,000 c.c. of 5 per cent saline and 500 c.c. of blood intravenously.

At operation a mid-line incision was made and the peritoneum was opened carefully on account of the great distention. There was a moderate amount of fluid in the peritoneal cavity. Exploration revealed a Meckel's diverticulum, arising about 20 inches above the ileocecal valve, which ran down freely, without a mesentery, to the right pelvic wall. At this point its distal end was attached to the tip of the appendix. Together the diverticulum and the appendix formed a band behind which a loop of ileum, just proximal to the diverticulum, had become lodged and obstructed (Fig. 2).

large calcium carbonate fecaliths within the latter.

The postoperative course was satisfactory. The sutures were removed on the tenth postoperative day, and the enterostomy tube on the twelfth day. Fifteen days after operation a small area of bronchopneumonia developed in the left mid-lung field, which responded to chemotherapy (sulfadiazine). The patient was discharged as completely recovered on the twenty-sixth postoperative day.

DISCUSSION

Pemberton and Stalker (7) have divided Meckel's diverticula into three clinical groups: (1) those which produce no symptoms and are incidental findings during surgical procedures for unrelated conditions; (2) those which produce intestinal obstruction; (3) those that produce intestinal bleeding. Inasmuch as the intestinal obstruction was the important clinical finding in our case, we have classified it in the second group.

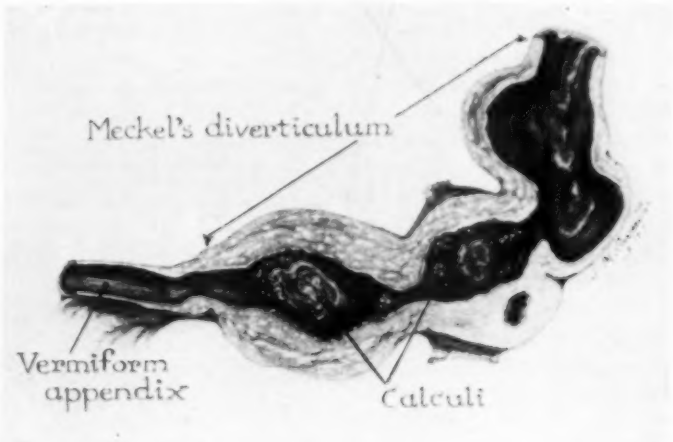

Fig. 4. Drawing of the opened specimen showing the two calcified concretions and the fistula between the Meckel's diverticulum and the appendix.

The main diverticulum came off near the mesenteric border of the ileum. It was doubly clamped at this point and sectioned; carbolic and alcohol were applied to the stump which was buried with a purse-string suture reinforced with interrupted catgut sutures. The mesentery of the appendix was clamped and tied. The appendix was removed in the usual manner, so that the whole loop, including the appendix and the diverticulum, was removed as one section of gut. In addition, an ileostomy was carried out through a small left rectus incision.

The pathological staff of the hospital returned the following diagnosis: chronic appendicitis and periappendicitis, chronic Meckel's diverticulitis and peridiverticulitis, Meckel's diverticulo-appendiceal fistula, and calcium carbonate fecaliths.

The artist's drawings depict far better than words can describe the operative and the surgical findings. Figures 2 and 3 show the mechanism which produced the intestinal obstruction and the gross specimen after removal. Figure 4, a drawing of the open specimen, shows the communication between the appendix and the diverticulum as well as the two

Undoubtedly, cases of this nature have occurred previously. One need only peruse the great volume of literature on Meckel's diverticulum to appreciate that all the pathological entities capable of occurring within any segment of the gastro-intestinal tract have been described as developing here. It is not difficult then to explain the sequence of pathologic events in this case. We believe that appendicitis with ad-

hesions and rupture into the diverticulum laid the ground work for the resultant intestinal obstruction. This would explain the persistent lumen between the two organs. An inflammatory process is a necessary prerequisite to the precipitation of calcium salts upon existing fecal material. The subsequent obstruction made possible by the band-like loop produced by the appendix and the diverticulum led to surgery.

The interesting and unusual part of this picture was the presence of radio-opaque calcified concretions of sufficient density to be visible on the roentgenogram of the abdomen. Our consideration of the differential diagnosis in this case did not include the correct diagnosis. Calcified mesenteric nodes are common at this site and this was our interpretation. Had the patient been a female, calcification within a pelvic tumor would certainly have been considered. It was suggested that these areas might have been gallstones, but there was no gas within the biliary tree, which is often the case under these circumstances (8). The size, shape, and position of the shadows did not suggest calcification within epiploic tags, ureteral stones, or calcified appendiceal concretions. We know from the history that the patient had not been given barium, nor had he taken any of the known opaque medications.

We present this case because of its unusual surgical, pathological, and roentgenological manifestations, rather than as an addition to the long list of pathological calcifications occurring within the abdominal cavity.

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EDITORIAL

Howard P. Doub, M. D., Editor

John D. Camp, M. D., Associate Editor

Medical Practice and the Blue Cross

Per ardua ad astra was the motto of many knights in the days when chivalry was in flower and did battle with the infidel. *Per ardua ad radiologia scientifica* might be the motto of many physicians and laymen today, men who have been battling the inclusion of diagnostic medical services in group hospitalization plans for almost a decade. These men realize that if a hospital can sell a radiologist's services today, it can sell a surgeon's tomorrow—and, in a short time, can become an advertising, competing corporation selling all branches of medical service. When competition becomes keen, the first thing which can and will be cut will be the quality of medical service. The profession will not dictate the changes; the corporation will.

The trend in government is toward centralization and regimentation. The trend in hospital practice is toward increased control of physicians and increased dictation as to the type of equipment they shall use and even the fees they shall charge. Neither government nor hospital corporation appears to grasp the inevitable results of these trends, which must be the elimination of the personal interest of the physician in his patient and the personal urge for scientific progress.

The new proposed uniform national contract of the Blue Cross Commission specifies the inclusion of radiological services as a part of hospital care. We have no quarrel whatsoever with Blue Cross plans which provide for strictly hospital services in their benefits, but when they attempt to encompass medical services, such as diagnostic radiology, we have a great and keen interest indeed. If the Blue Cross Plan Commission of the American Hospital Association would revise the wording of its contract, and arrange for the provision of hospital services only, it would comply with the considered recommendations of the organized medical profession and eliminate with one stroke a grave source of friction between the profession and the hospital organizations.

We as radiologists are keenly aware of this problem, but are our colleagues in other branches of medicine? Do they realize that if some branches of medicine are allowed to slip into permanent hospital domination today, almost all branches of medical practice must follow? What can be done about the situation?

First, awaken your colleagues to the current state of affairs. Show them the editorials in the *Journal of the American Medical Association* for July 31, 1943 (The Practice of Radiology and Hospital Service Plans), in the Westchester County Medical Society *Bulletin* for August 1943 (Hospital Practice and the Public Interest), and in the San Francisco County Medical Society *Bulletin* for October 1943 (Hospital Control of Medicine).

Second, develop the identification of your own practice in your hospital. Your colleagues know that you are trained and skilled in radiology. When they themselves want to have a stomach examination, a "lumbosacral," or a sinus study, they come to you as a radiologist. But too often their patients regard you as an unknown hospital functionary. They will regard you as a radiologist only when you identify yourself as such—both by written and spoken word. Especially important in this connection is the rendering of bills

to private patients in your own name, not the hospital's—or, at least, the imprint of your name on the x-ray statement. Legally and ethically a corporation should not bill for a professional man's services. You will therefore be assisting both your hospital and your profession in emphasizing the identity of radiology as a medical procedure done by the radiologist, and not by a hospital.

Third, give every possible assistance to Blue Cross plans that provide for strictly hospital benefits. Even though not a single Blue Cross plan has been approved to date by the organized medical profession, a few do comply with the major principles of our profession (especially with principle number 4 defining hospital care. See *Journal of the American Medical Association* for June 19, 1943, page 531).

Fourth, give every possible assistance to state medical association sponsored (and medically controlled) voluntary Health Insurance or Medical Service Plans. As Dawson of Penn says: "We must innovate greatly but quietly." We must develop better methods of distributing medical services to all the people. But in so innovating we must not eradicate the quality and standards of medical practice. Else the public gets a hollow shell—a beautiful medical benefits plan *on paper*. As a writer recently observed concerning New Zealand's plan, "the provision of free hospital beds for all sounds very well, but unfortunately there aren't any vacant beds!"

Hospital or government controlled schemes tend to result in the doctor being responsible to the institution or the local political chief, rather than to the patient. Outside of a handful of large teaching or research institutions, this usually means responsibility to some lay board of trustees. When the personal responsibility of the doctor to the patient terminates, the welfare of the latter inevitably suffers. If Blue Cross really desires to provide worth-while medical benefits along with hospital care, it can do so in co-operation with the medical profession by means of joint policies (providing anything from simple diagnostic medical services up to deductible "catastrophic" inclusive medical benefits). But these medical benefits should be furnished by and under the control of the medical profession.

CONTRIBUTED

ANNOUNCEMENTS AND BOOK REVIEWS

CANCER TEACHING DAY

Cancer Teaching Day was observed in Poughkeepsie, N. Y., and Olean, N. Y., on Nov. 10 and 11, respectively. In Poughkeepsie the meetings were conducted under the auspices of the Dutchess County Medical Society, Dutchess County Tumor Clinic, the Tumor Clinic Association of the State of New York, the New York State Medical Society, and the Division of Cancer Control of the State Department of Health. The speakers were Dr. Norman Treves, Dr. Lloyd F. Craver, and Dr. Archie L. Dean, of Memorial Hospital, New York City; Dr. Arthur J. Wallingford, Executive Head of the Department of Obstetrics and Gynecology, Albany Medical College and Albany Hospital, Albany, N. Y.; Dr. Maurice Lenz, Professor of Clinical Radiology, College of Physicians and Surgeons, Columbia University, New York City.

The Olean program was presented under the auspices of the Cattaraugus County Medical Society, the New York State Medical Society, and the Division of Cancer Control of the State Department of Health. Dr. Lloyd F. Craver of Memorial Hospital and Dr. Clyde L. Randall, Professor of Gynecology in the University of Buffalo School of Medicine, were the speakers.

ERRATUM

In the paper on "Fluoride Osteosclerosis from Drinking Water," by Major Joseph F. Linsman, M.C., and Major Crawford A. McMurray, M.C., in RADIOLOGY for May 1943, the fluorine content of the drinking water in Spur, Texas, is unfortunately given as 12 parts per million, instead of 1.2 parts per million (Vol. 40, page 474, fifth line of second column).

CUMULATIVE INDEX
1923–1942

The Editorial Office is happy to be able to announce the completion of the Cumulative Index of RADIOLOGY, covering Volumes 1 to 39, 1923 to 1942. The index, which has been in course of preparation for more than two years, covers both original contributions and abstracts and includes both author and subject headings, so arranged as to form a complete guide to the published material of twenty years. The work is now on the press and will shortly be ready for distribution. Further information appears on another page of this issue.

In Memoriam

ISAR G. FOX, M.D.
1900–1943

Dr. Isar G. Fox of Harlingen, Texas, died on July 15, 1943, of acute leukemia. Doctor Fox was born in Galveston, Texas, in 1900, was graduated from the University of Texas School of Medicine, and subsequently did postgraduate work at the University of Pennsylvania, specializing in radiology. He was a diplomate of the American Board of Radiology and a member of the Radiological Society of North America.

GEORGE C. CHENE, M.D.
1882–1943

Dr. George C. Chene of Detroit, Mich., died in September 1943. Doctor Chene was born in Windsor, Ontario. He received his medical education in Detroit and for thirty years was a member of the staff of Providence Hospital in that city. He was a member of the American Roentgen Ray Society and the Radiological Society of North America.

DAVID YANDELL KEITH, M.D.
1881–1943

Word has been received of the death of Dr. David Yandell Keith, of Louisville, Ky. Doctor Keith was graduated from the University of Louisville in 1909 and was shortly thereafter appointed to the teaching staff, of which he remained a member throughout his life. At the time of his death he was Professor of Radiology. He was a diplomate of the American Board of Radiology and a member of the American College of Radiology and the American Radium and American Roentgen-Ray Societies.

Books Received

THE MEDICAL ANNUAL 1943. A YEAR BOOK OF TREATMENT AND PRACTITIONER'S INDEX. Editors: Sir HENRY TIDY, K.B.E., M.A., M.D. (Oxon.), F.R.C.P., and A. RENDLE SHORT, M.D., B.S., B. Sc., F.R.C.S. Published by John Wright & Sons Ltd., Bristol, and Simpkin Marshall (1941) Ltd., London.

A HUNDRED YEARS OF MEDICINE. By C. D. HAAGENSEN AND WYNDHAM E. B. LLOYD. A volume of 444 pages, with 42 illustrations. Published by Sheridan House, Inc., New York. Price $3.75.

RADIOLOGICAL SOCIETIES OF NORTH AMERICA

Editor's Note.—Will secretaries of societies please cooperate by sending information to Howard P. Doub, M.D., Editor, Henry Ford Hospital, Detroit, 2 Mich.

UNITED STATES

Radiological Society of North America.—Secretary, D. S. Childs, M.D., 607 Medical Arts Building, Syracuse, N. Y.

American Roentgen Ray Society.—Secretary, Harold Dabney Kerr, M.D., Iowa City, Iowa.

American College of Radiology.—Secretary, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

Section on Radiology, American Medical Association.—Secretary, J. T. Murphy, M.D., 421 Michigan St., Toledo, Ohio.

ARKANSAS

Arkansas Radiological Society.—Secretary-Treasurer, J. S. Wilson, M.D., Monticello. Meets every three months and annually at meeting of State Medical Society.

CALIFORNIA

California Medical Association, Section on Radiology.—Secretary, Joseph D. Coate, M.D., 434 Thirtieth St., Oakland.

Los Angeles County Medical Association, Radiological Section.—Secretary, Donald R. Laing, M.D., 65 N. Madison Ave., Pasadena. Meets second Wednesday of each month at County Society Building.

Pacific Roentgen Society.—Secretary-Treasurer, L. Henry Garland, M.D., 450 Sutter St., San Francisco. Society meets annually during annual meeting of the California Medical Association.

San Francisco Radiological Society.—Secretary, Sydney F. Thomas, M.D., San Francisco Hospital. Meets monthly on third Thursday at 7:45 P.M., in Toland Hall, University of California Hospital.

COLORADO

Denver Radiological Club.—Secretary, Edward J. Meister, M.D., 366 Metropolitan Bldg. Meetings third Friday of each month at the Denver Athletic Club.

CONNECTICUT

Connecticut State Medical Society, Section on Radiology.—Secretary-Treasurer, Max Climan, M.D., 242 Trumbull St., Hartford. Meetings bimonthly, on second Thursday. Place of meeting selected by Secretary.

FLORIDA

Florida Radiological Society.—Acting Secretary, Walter A. Weed, M.D., 204 Exchange Building, Orlando.

GEORGIA

Georgia Radiological Society.—Secretary-Treasurer, James J. Clark, M.D., 478 Peachtree St., N. E., Atlanta. Meetings twice annually, in November and at the annual meeting of State Medical Association.

ILLINOIS

Chicago Roentgen Society.—Secretary, Warren W. Furey, M.D., 6844 S. Oglesby Ave. Meets at the Palmer House, second Thursday of October, November, January, February, March, and April.

Illinois Radiological Society.—Secretary-Treasurer, William DeHollander, M.D., St. Johns' Hospital, Springfield. Meetings quarterly by announcement.

Illinois State Medical Society, Section on Radiology.—Secretary, Fay H. Squire, M.D., 1753 W. Congress St., Chicago.

INDIANA

The Indiana Roentgen Society.—Secretary-Treasurer, Harold C. Ochsner, M.D., Methodist Hospital, Indianapolis. Annual meeting in May.

IOWA

The Iowa X-ray Club.—Holds luncheon and business meeting during annual session of Iowa State Medical Society.

KENTUCKY

Kentucky Radiological Society.—Secretary-Treasurer, Sydney E. Johnson, M.D., Louisville City Hospital, Louisville. Meeting annually in Louisville, third Saturday afternoon in April.

LOUISIANA

Louisiana Radiological Society.—Secretary-Treasurer, Johnson R. Anderson, M.D., North Louisiana Sanitarium, Shreveport. Meets annually at same time as State Medical Society.

Shreveport Radiological Club.—Secretary-Treasurer, R. W. Cooper, 940 Margaret Place. Meetings monthly on the second Wednesday, at the offices of the various members.

MARYLAND

Baltimore City Medical Society, Radiological Section.—Secretary, Walter L. Kilby, M.D., 101 W. Read St. Meetings are held the third Tuesday of each month.

MICHIGAN

Detroit X-ray and Radium Society.—Secretary-Treasurer, E. R. Witwer, M.D., Harper Hospital, Detroit. Meetings first Thursday of each month from October to May, inclusive, at Wayne County Medical Society club rooms, 4421 Woodward Ave., Detroit.

Michigan Association of Roentgenologists.—Secretary-Treasurer, E. M. Shebesta, M.D., 1429 David Whitney Bldg., Detroit. Meetings quarterly by announcement.

MINNESOTA

Minnesota Radiological Society.—Secretary, John P. Medelman, M.D., 572 Lowry Medical Arts Bldg., St. Paul. Meetings quarterly.

MISSOURI

Radiological Society of Greater Kansas City.—Secretary, Arthur B. Smith, M.D., 306 E. 12th St., Kansas City, Mo. Meetings last Thursday of each month.

The St. Louis Society of Radiologists.—Secretary, Paul C. Schnoebelen, M.D., 462 N. Taylor Ave. Meets on fourth Wednesday of each month except June, July, August, and September, at a place designated by the president.

NEBRASKA

Nebraska Radiological Society.—Secretary, F. L. Simonds, M.D., 1216 Medical Arts Bldg., Omaha. Meetings third Wednesday of each month at 6 P.M. in either Omaha or Lincoln.

NEW ENGLAND

New England Roentgen Ray Society (Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island).—*Secretary,* Hugh F. Hare, M.D., Lahey Clinic, Boston, Mass. Meets monthly on third Friday at Boston Medical Library.

NEW JERSEY

Radiological Society of New Jersey.—Secretary, H. J. Perlberg, M.D., Trust Co. of New Jersey Bldg., Jersey City. Meetings at Atlantic City at time of State Medical Society and midwinter in Newark as called by president.

NEW YORK

Associated Radiologists of New York, Inc.—Secretary, William J. Francis, M.D., 210 Fifth Ave., New York City. Regular meetings the first Monday evening of the month in March, May, October, and December.

Brooklyn Roentgen Ray Society.—Secretary-Treasurer, Leo Harrington, M.D., 880 Ocean Ave. Meetings held the fourth Tuesday of every month, October to April.

Buffalo Radiological Society.—Secretary-Treasurer, Joseph S. Gianfranceschi, M.D., 610 Niagara St. Meetings second Monday evening each month, October to May, inclusive.

Central New York Roentgen Ray Society.—Secretary-Treasurer, Carlton F. Potter, M.D., 425 Waverly Ave., Syracuse. Meetings are held in January, May, and October, as called by Executive Committee.

Long Island Radiological Society.—Secretary, Marcus Wiener, M.D., 1430 48th St., Brooklyn. Meetings fourth Thursday evening each month at Kings County Medical Bldg.

New York Roentgen Society.—Secretary, Haig H. Kasabach, Presbyterian Hospital, New York, N. Y.

Rochester Roentgen-ray Society.—Secretary, S. C. Davidson, M.D., 277 Alexander St. Meetings at convenience of committee.

NORTH CAROLINA

Radiological Society of North Carolina.—Secretary-Treasurer, Major I. Fleming, M.D., 404 Falls Road, Rocky Mount. Meeting with State meeting in May, and meeting in October.

NORTH DAKOTA

North Dakota Radiological Society.—Secretary, L. A. Nash, M.D., St. John's Hospital, Fargo. Meetings by announcement.

OHIO

Ohio Radiological Society.—Secretary, J. E. McCarthy, M.D., 707 Race St., Cincinnati. The next meeting will be held at the time and place of the annual meeting of the Ohio State Medical Association.

Cleveland Radiological Society.—Secretary-Treasurer, Don D. Brannan, M.D., 11311 Shaker Blvd., Cleveland 4. Meetings at 6:30 P.M. on fourth Monday of each month from October to April, inclusive.

Radiological Society of the Academy of Medicine (Cincinnati Roentgenologists).—*Secretary-Treasurer,* Samuel Brown, M.D., 707 Race St. Meetings held third Tuesday of each month.

PENNSYLVANIA

Pennsylvania Radiological Society.—Secretary-Treasurer, L. E. Wurster, M.D., 416 Pine St., Williamsport. The Society meets annually.

The Philadelphia Roentgen Ray Society.—Secretary, Robert P. Barden, M.D., 3400 Spruce St., Philadelphia. Meetings held first Thursday of each month at 8:15 P.M., from October to May, in Thomson Hall, College of Physicians, 21 S. 22nd St., Philadelphia.

The Pittsburgh Roentgen Society.—Secretary-Treasurer, Reuben G. Alley, M.D., 4800 Friendship Ave., Pittsburgh, Pa. Meetings are held on the second Wednesday of each month at 4:30 P.M., from October to June, at the Pittsburgh Academy of Medicine, 322 N. Craig St.

ROCKY MOUNTAIN STATES

Rocky Mountain Radiological Society (North Dakota, South Dakota, Nebraska, Kansas, Texas, Wyoming, Montana, Colorado, Idaho, Utah, New Mexico).—*Secretary,* A. M. Popma, M.D., 220 North First St., Boise, Idaho.

SOUTH CAROLINA

South Carolina X-ray Society.—Secretary-Treasurer, Robert B. Taft, M.D., 103 Rutledge Ave., Charleston. Meeting in Charleston on first Thursday in November, also at time and place of South Carolina State Medical Association.

TENNESSEE

Memphis Roentgen Club.—Chairmanship rotates monthly in alphabetical order. Meetings second Tuesday of each month at University Center.

Tennessee Radiological Society.—Secretary-Treasurer, J. Marsh Frère, M.D., 707 Walnut St., Chattanooga. Meeting annually with State Medical Society in April.

TEXAS

Texas Radiological Society.—Secretary-Treasurer, Herman Klapproth M.D., Sherman.

VIRGINIA

Virginia Radiological Society.—Secretary, E. Latané Flanagan, M.D., 215 Medical Arts Bldg., Richmond.

WASHINGTON

Washington State Radiological Society.—Secretary-Treasurer, Thomas Carlile, M.D., 1115 Terry Ave., Seattle. Meetings fourth Monday of each month, October through May, at College Club, Seattle.

WISCONSIN

Milwaukee Roentgen Ray Society.—Secretary-Treasurer, C. A. H. Fortier, M.D., 231 W. Wisconsin Ave., Milwaukee. Meets monthly on second Monday at the University Club.

Radiological Section of the Wisconsin State Medical Society.—Secretary, Russell F. Wilson, M.D., Beloit Municipal Hospital, Beloit. Two-day annual meeting in May and one day in connection with annual meeting of State Medical Society, in September.

University of Wisconsin Radiological Conference—Secretary, E. A. Pohle, M.D., 1300 University Ave., Madison, Wis. Meets every Thursday from 4 to 5 P.M., Room 301, Service Memorial Institute.

CANADA

Canadian Association of Radiologists.—Honorary Secretary-Treasurer, A. D. Irvine, M.D., 540 Tegler Bldg., Edmonton, Alberta.

La Société Canadienne-Française d'Eléctrologie et de Radiologie Médicales.—General Secretary, Origène Dufresne, M.D., Institut du Radium, Montreal. Meetings are held the third Saturday of each month, generally at the Radium Institute, 4120 East Ontario Street, Montreal; sometimes, at homes of members.

CUBA

Sociedad de Radiología y Fisioterapia de Cuba.—Offices in Hospital Mercedes, Havana. Meetings are held monthly.

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ROENTGEN DIAGNOSIS

THE HEAD AND NECK

Radiological Diagnosis of Craniolacunia. J. Blair Hartley and C. W. F. Burnett. Brit. J. Radiol. **16:** 99–108, April 1943.

The incidence of craniolacunia is more common than the literature would indicate. Figures from three maternity hospitals with large services show an incidence varying from 0.85 per cent to 3.1 per cent. The diagnosis may be made before delivery.

Craniolacunia is an anomaly of the developing bones of the vault, formerly called Lückenschädel. It is usually associated with other developmental anomalies. A mild form, for which the authors would retain the designation *craniolacunia*, is characterized by depressions on the inner surface of the vault bones. A more severe form, for which they suggest the name *craniofenestria*, shows actual areas of absence of bone formation.

The presence of hydramnios or hydrocephalus suggests the advisability of an antenatal radiological study of the fetus. The presence of anomalies at birth are also indications for an x-ray examination of the skull.

At least two films are required for antenatal diagnosis, an anteroposterior and a right or left lateral, depending upon which maternal side the fetal head is nearer. Instead of a smooth even density representing the skull bones, there will be irregularities in thickness and areas where the bone density is absent. The shape of the skull may be abnormal. In some cases the shadow will be duplicated. Sometimes the skull bones may be entirely invisible. Spinal defects are often observed at the same time.

The postnatal diagnosis is not difficult. At this time a differentiation between craniolacunia and craniofenestria may be made. Frequently the bulging of the cranial contents through the defects may be observed. The presence of hydrocephalus may lead to difficulties in the diagnosis, but the presence of other anomalies is in favor of craniolacunia.

Craniolacunia in itself is of no particular danger. A complicating hydrocephalus is of serious prognosis. The identification of craniolacunia ante partum is particularly useful, as it usually indicates other developmental anomalies, previous knowledge of which may affect the conduct of labor.

SYDNEY J. HAWLEY, M.D.

Osteochondromas Arising from the Base of the Skull. C. F. List. Surg., Gynec. & Obst. **76:** 480–492, April 1943.

This article presents 7 cases of osteochondroma arising from the base of the skull. Five of the tumors were primarily intracranial and 2 primarily extracranial. Four of the first group originated from the sphenoid bone and protruded intracranially in the posterior parasellar region, indenting and displacing the leptomeninges and brain. The fifth tumor of this group was but one manifestation of a generalized chondromatosis. The 2 extracranial tumors arose in the sphenoidal and ethmoidal regions and grew in an extracranial direction until a comparatively late stage, when they invaded the cranial cavity.

In view of the site of development of these lesions, it is probable that they develop from remnants of the cartilaginous primordial cranium. They are found in a location similar to that of chordomas, which arise from the notochord. The histology is characteristic, though the tumors may show considerable variation, some consisting almost entirely of mature cartilage and others containing elements of adult or embryonic mesenchymal tissue. Most show areas of ossification and degenerative changes, such as calcification or mucinous degeneration. Occasionally one undergoes sarcomatous change.

These tumors, as a rule, occur in young adults; their rate of growth is slow, a clinical course of ten or twenty years being not uncommon. As a result of their parasellar location, they produce a characteristic clinical syndrome, usually affecting the structures in the wall of the cavernous sinus at an early stage, paresis of the 3d, 4th, 5th, and 6th cranial nerves almost always being shown. Neuralgic pains and sensory loss are common. Headaches from irritation of the dura frequently cause nausea and vomiting, but basal osteochondromas rarely produce definite signs of increased intracranial pressure. The venous return to the cavernous sinus is often mechanically impaired and the optic pathway usually becomes implicated. When the tumors encroach upon the hypophysis and its stalk and the hypothalamic region, the pituitary-hypothalamic syndrome may develop. Other signs and symptoms depend upon the direction and extent of growth.

Roentgenologically, these tumors are manifested by localized erosion of bone combined with dense calcification in the tumor. Intracranial sphenoidal osteochondromas produce parasellar erosion of greater or less degree. Calcification in these lesions either takes the form of coarse flakes or may be so dense as to simulate cancellous bone, thus outlining the entire mass of the tumor. In the ethmoidal region various areas of bone may be destroyed.

In the differential diagnosis the following must be ruled out: (*a*) subclinoid (parasellar) aneurysm of the internal carotid artery, (*b*) parasellar meningiomas, (*c*) craniopharyngiomas, and (*d*) chordomas.

Since osteochondromas do not respond to radiation, surgery is the only promising form of therapy. The best access is by a low frontotemporal osteoplastic craniotomy combined with subtemporal decompression. Most of the tumors are broken up during removal, and their complete extirpation is almost impossible. Because of the slow rate of growth, however, the patients can look forward to a long period of symptomatic relief following operation, unless sarcomatous change has taken place. The roentgenograms reproduced in this paper show the lesions well.

JOHN O. LAFFERTY, M.D.

Utility of Roentgenograms of the Neck in Tumors of the Larynx and Hypopharynx. F. Urfer. Schweiz. med. Wchnschr. **72:** 1353–1355, Dec. 5, 1942.

The technic of examination and the findings in laryngeal and hypopharyngeal tumors have been previously described by several authors. The lateral view is the most informative. A film taken during the Valsalva maneuver is often useful, and in some instances a contrast medium may help, especially if it is layered on the mucosa and tumor. These methods are especially useful when clinical examination fails to show

the tumor, and in demonstrating involvement of the laryngeal skeleton. The origin and exact extent of the tumor are also better shown on the roentgenogram. Such information may help in determining operability (the author prefers laryngectomy for operable endolaryngeal tumors) and may assist in prognosis. No statistical material is included in the article.

LEWIS G. JACOBS, M.D.

THE CHEST

Pneumonia Complicating Mild Respiratory Infections. R. P. Becker. Canad. M. A. J. **48:** 324–333, April 1943.

Becker mentions the infrequency of old-fashioned pneumonias with acute onset and physical findings of dullness and bronchial breathing. The incidence and type of infection are known to vary from year to year in a given locality from both a clinical and bacteriological standpoint. Aside from the better known variations, however, there is another less recognized group, comprised of cases differing in onset, physical findings, course, and prognosis, and without significant numbers of organisms, such as pneumococci, streptococci, etc., in either sputum or blood stream. Roentgenographic examination of the chest in these patients, who do not present clear-cut signs or symptoms of pulmonary disease, is often a necessity. The apparent increase in incidence, therefore, is probably due to more painstaking examinations rather than changes in virulence of infection.

Mention is made of the frequency of occurrence of bronchopneumonia during the course of the common cold and it is pointed out that, while in most cases there may be no serious after-effects, incomplete cure may lead to serious pulmonary complications. The onset of such complications is varied: they may appear suddenly, may follow a sore throat or flu-like attack, or may occur in connection with vague complaints of anorexia, lassitude, or slight fever. Physical signs also show a wide variation, depending on size and location of the lesion.

Various names applied to these pneumonias are discussed, but the writer feels that most of them, including silent bronchopneumonia, virus pneumonia, pneumonitis, etc., are misnomers and chooses to designate the lesion as an "obstructive bronchopneumonia," the nomenclature being not so important as a realization of the frequency of occurrence. He qualifies his choice by the fact that these so-called "atypical pneumonias" are due frequently to some degree of bronchial or of bronchiolar obstruction; when bronchial patency is restored the pneumonia clears rapidly, without after-effects, but when drainage cannot be effected the pulmonary infection progresses and varying degrees of parenchymal destruction result.

Roentgenographically the lesions are variable in size, shape, location, and density, usually fairly well localized, poorly defined, and occurring most frequently in the basal region or as hazy infiltration from the hilar area to the periphery. Another quite common radiographic finding is displacement of thoracic organs, seen most frequently when the pneumonic area is in the lower lung field. This is important because this displacement disappears usually with disappearance of the pulmonary changes. In some cases, however, the pulmonary area clears, leaving thoracic organs still displaced and it is interesting that where this occurs the patient, as a rule, continues to have mild symptoms of lassitude, low-grade fever, anorexia, elevated red blood sedimentation rate, etc. When such displacement of heart and/or diaphragm is noted it may well be regarded as evidence of previous pneumonic injury with resultant incomplete anatomical cure.

M. L. CONNELLY, M.D.

Ghon's Tubercle: Re-evaluation of a Concept. R. G. Bloch. Am. J. Roentgenol. **49:** 463–468, April 1943.

The study of large groups of persons in case-finding programs for tuberculosis demonstrates that calcified lesions are found more frequently in the older groups and that the incidence of such calcification shows a continued rise throughout the later age period. The author believes that such studies indicate that a large number of calcified foci in the adult are the remnants not of a primary infection but rather of reinfection tuberculosis acquired during adult life. With decreasing exposure of children to the tubercle bacillus, especially in some rural areas of the country, the occurrence of late primary infection has undoubtedly increased, but this shift is as yet of little significance in the general picture of tuberculous epidemiology, especially in the cities. In the middle-aged and near-senile population the significance of first infection is to be denied.

Clinical and roentgenologic observations on the part of the author revealed great similarity, and in many cases complete parallelism, between primary and assumed superinfection foci. In numerous examinations of persons who were known to have been exposed to recent tuberculous infection, small, usually caseous lesions were found in the lung fields on roentgen examination. Hardly any of these had caused symptoms and they would not have been discovered except for the fact that the patient was being examined because of contact with an active case. Some of these small infiltrates were observed to disappear by reabsorption in the course of a few months or years. Others persisted, with slowly progressive encapsulation, deposition of calcium salts, and eventually calcification. The age of persons, in whom these observations were made ranged up to 67 years.

In the light of these observations, the only justifiable interpretation that can be placed on the finding of a calcified tuberculous lesion by roentgen examination is that it represents the innocuous residuum of a tuberculous infection, either a primary infection or reinfection at some prior time, either in childhood or adulthood, without its being possible to determine the time at which the infection occurred. The term, "Ghon's tubercle," therefore, should either be dissociated entirely from the time element and applied to all small calcifying or calcified foci, regardless of age, or if it is to be retained as signifying the residuum of a childhood infection, it should be applied only to calcified foci in the child.

L. W. PAUL, M.D.

Pulmonary Calcification and Tuberculin Sensitivity among Children in Williamson County, Tennessee. R. S. Gass, E. F. Harrison, Ruth R. Puffer, H. C. Stewart, and W. C. Williams. Am. Rev. Tuberc. **47:** 379–387, April 1943.

Previous radiographic studies of school children in Williamson County, Tennessee, revealed a high frequency of calcified lesions in the lung fields and tracheo-

bronchial lymph nodes. Following the most recent survey, in 1941, a complete restudy was made of all x-ray films of children who had been included in two or three of the studies. An unusual finding, in view of the fact that such calcification is usually considered to be tuberculous, was that the incidence of these lesions was only slightly higher among tuberculin-positive than among tuberculin-negative children.

In all, 935 white and 235 colored school children were examined in two of the school studies and some of these were examined on three separate occasions. A review of these serial roentgenograms shows that 83 per cent of the white and 72 per cent of the colored school children had calcified lesions in the lungs or tracheobronchial lymph nodes. The data provided according to age group at the time of first examination indicate that these children acquire pulmonary calcification at a very early age. In the review of the serial films 31 children who had no evidence of calcification on the first examination were found to have acquired it prior to the last film.

Tuberculin tests were completed for 881 white children. Among those with extensive calcification, 15.7 per cent reacted to 0.01 mg.; among those without calcification, but 5.9 per cent reacted to 0.01 mg. Among the colored children the same tendency was noted. No explanation is offered for the unusually high incidence of calcification in these children and its association with tuberculin anergy. L. W. PAUL, M.D.

Natural History of Tuberculous Tracheobronchitis. D. Salkin, A. V. Cadden, and R. C. Edson. Am. Rev. Tuberc. **47:** 351–369, April 1943.

In this report are presented the results of a study of tuberculous tracheobronchitis in a group of 125 consecutive autopsies on patients dying from pulmonary tuberculosis and another group of 622 consecutive admissions to a tuberculosis sanitarium covering the same period of time. In 50 of the postmortem group, or 40 per cent, tuberculous lesions in the trachea and large and medium-sized bronchi were present. The exudative cases presented the highest incidence of tracheobronchitis, followed by the mixed cases and then the fibroid. The high incidence of bronchitis in lower lobe disease was noteworthy. The age of the patient and the duration of the disease were found to be of no significance. The lesions commonly seen included all varieties of ulcers, submucosal nodules, fibrous and inflammatory stenoses.

No symptom or group of symptoms was found to be pathognomonic of tracheobronchitis. Unusually severe cough, variable and copious sputum, and substernal discomfort were suggestive. In the group upon which the clinical study was based, all patients received an initial routine bronchoscopy and in positive cases this procedure was repeated every three to six months thereafter. Of the 622 patients, 64, or 10 per cent, showed a tuberculous lesion on the first examination. Eventually 33 more cases showed positive bronchial findings, making a total of 97, or 15.5 per cent of the group. The changes observed bronchoscopically were classified as non-ulcerative, ulcerative, and stenotic.

The roentgenologic signs in the presence of tracheobronchial tuberculosis are listed as follows: (1) Blocked cavities. These occurred in 6 per cent of the group with normal bronchi and in 9 per cent of those with diseased bronchi. (2) Evidence of bronchial irregularities demonstrable on overexposed films, Bucky films, tomograms, and bronchograms. (3) Atelectasis or a uniform airlessness of a lung, a lobe, or part of a lobe. Small patchy lobular areas were not included because of the difficulty in differentiating them from true spread. Atelectasis was present in 12 per cent of the negative group and 36 per cent of the positive cases. Its incidence was higher in the clinical than in the autopsy group, possibly due to the fact that by the time the patient died, the previously atelectatic area may have been included in a progressive, caseous, and cavernous process. (4) Bronchiectasis as proved by bronchograms, showing saccules and dilatations large enough to be of clinical significance. Relatively few bronchograms were made. In the negative group significant ectasia was present in 43 cases, or 8 per cent, and in the positive group in 14 cases, or 14 per cent. Most of the saccules and dilatations were present at the site of the parenchymal disease, but in about 21 per cent of each group they occurred chiefly distal to the main pulmonary lesion.

In the pathogenesis of tracheobronchial tuberculosis, several factors are important, including the following: (1) most cases of bronchitis occur on the side of the more extensive lesion; (2) the great majority are associated with positive sputum and cavity; (3) the incidence is high in lower lobe disease where sputum drainage is less effective; (4) the incidence of bronchitis increases as one approaches a cavity. Cases with bronchitis show a more severe clinical course and have a poorer prognosis than those in which the bronchi are normal, but if the parenchymal lesion is controlled and inactivated, tuberculous bronchitis will heal spontaneously in about 80 per cent of all patients. L. W. PAUL, M.D.

Bronchiectasis and Dextrocardia: Observations on the Etiology of Bronchiectasis. A. M. Olsen. Am. Rev. Tuberc. **47:** 435–439, April 1943.

The simultaneous occurrence of bronchiectasis and sinus disease accompanying transposition of the viscera has been called "Kartagener's triad." The frequency of occurrence of this syndrome has served as a powerful argument in favor of the theory of a congenital origin of bronchiectasis. It is generally recognized that bronchiectasis and disease of the accessory nasal sinuses are commonly associated.

The observations here recorded are based upon a total of 85 patients who had true congenital dextrocardia, encountered at the Mayo Clinic. Definite evidence of bronchiectasis was present in 14, or 16.5 per cent of this group. In the same period a diagnosis of bronchiectasis was made in less than half of one per cent of the total number of patients who registered at the Clinic. Clinical experience demonstrates that the manifestations of bronchiectasis most often appear after the precipitating factors of bronchial obstruction, atelectasis, and infection. Such influences, however, are more likely to provoke the clinical syndrome in persons whose bronchi are peculiarly susceptible to dilatations than among others. Thus, both congenital and acquired components probably enter into the production of the disease in most instances. L. W. PAUL, M.D.

Tuberculosis in Industry. H. R. Edwards. Am. J. M. Sc. **205:** 571–581, April 1943.

Industry is now operating at its maximum and is, therefore, placing a greater strain on the worker than ever before. This increased strain will result in many

breakdowns of active tuberculous lesions as well as latent or unhealed processes.

The spread of tuberculosis is conditioned in large part by the number of infectious cases in the community. In an examination of over 15,000 union workers in various industries in New York City the incidence of clinically significant disease was found to be 0.61 per cent, of apparently arrested chronic pulmonary tuberculosis 2.92 per cent, and of healed primary lesions 12.43 per cent.

Surveys of this type should be the basis for a program of medical care for the industrial employee which should be the joint responsibility of labor and management.

BENJAMIN COPLEMAN, M.D.

Pulmonary Fibrosarcoma of the Chest Wall Following Thoracic Trauma. J. M. Blake and J. K. Bradford. J. Thoracic Surg. **12:** 368–375, April 1943.

A 20-year-old man gave a history of fractures of the right fifth and sixth ribs at the age of 16 years. These fractures healed and there were no further symptoms until a second injury to the same area 6 months before admission. No roentgenograms were taken at that time. The pain persisted and the patient lost 40 pounds in weight. He had no pulmonary symptoms.

Examination revealed a mass on the anterior lateral aspect of the right chest wall at the level of the fifth and sixth ribs, with a large smooth intrathoracic extension and destruction of the sixth rib. The mass was explored and found inoperable because of soft tissue invasion posteriorly and metastatic thrombosis of a vessel on the chest wall. Radiation therapy (3,900 r in 14 days) had no effect on the tumor. Death occurred twenty-one months after the second chest injury. Autopsy showed a large fibrosarcoma of the chest wall and pulmonary metastases. The most interesting feature was a nodule occluding the right lower lobe bronchus. This bronchial mass had a broad pedicle and, although no mention was made of its histological structure, it is assumed that it was a metastasis.

As usual, it was not possible to establish definitely the relationship between the injury and the tumor. In any case of trauma where symptoms persist after the injury should have healed, a complete examination including roentgenograms should be made.

HAROLD O. PETERSON, M.D.

Bronchial Adenoma with Metastasis to the Liver. W. M. Anderson. J. Thoracic Surg. **12:** 351–360, April 1943.

Until 1937 there had been no report of a bronchial adenoma metastasizing. Since then several cases have been recorded with metastasis to adjacent lymph nodes or showing microscopic metastases in a vertebra or the liver. The authors present a case of bronchial adenoma in a 40-year-old male with a 2-cm. metastasis in the liver. They conclude that bronchial adenomas should be treated like other malignant neoplasms. A general discussion is presented concerning the origin and malignancy of these tumors.

HAROLD O. PETERSON, M.D.

Bronchial Involvement in Metastatic Pulmonary Malignancy. D. S. King and B. Castleman. J. Thoracic Surg. **12:** 305–315, April 1943.

Contrary to the usual belief that metastatic carcinoma does not involve the bronchi, the authors feel that this occurs quite commonly. They also believe that bronchial obstruction and pulmonary hemorrhage simulating a primary carcinoma of the lung may occur with metastatic tumors, although rarely. They reviewed autopsy records of 109 patients with metastases to the lungs. In 20 of these cases there was evidence of bronchial involvement, either erosion of the tumor into the lumen of a bronchus or metastasis directly to the bronchial wall. Only four of these patients had hemoptysis. In 14 cases the neoplasm was carcinoma and in 6 sarcoma. The authors conclude that a metastatic pulmonary neoplasm may simulate a primary tumor and that hemoptysis cannot be considered as pathognomonic of a primary growth.

HAROLD O. PETERSON, M.D.

Congenital Cysts of the Mediastinum: Report of Three Cases Including a Gastric Cyst. H. A. Carlson. J. Thoracic Surg. **12:** 376–393, April 1943.

This article presents a good short review of congenital cysts of the mediastinum. There are in addition 3 case reports,of a gastric cyst, a bronchial cyst, and a teratoma. Congenital cysts known to occur in the mediastinum, with their sources, are as follows:

(1) Epidermoid cysts—ectoderm
(2) Dermoid cysts—ectoderm and mesoderm
(3) Teratomas—ectoderm, entoderm, mesoderm
(4) Cystic lymphangiomas—mesoderm
(5) Pericardial coelomic cysts—mesoderm
(6) Bronchial cysts—entoderm and mesoderm
(7) Gastric cysts—entoderm and mesoderm
(8) Enteric cysts—entoderm and mesoderm

The first three can be grouped together, since they present a similar clinical and roentgenologic picture. They occur in the anterior mediastinum but may become large enough to protrude into both lung fields and also fill the entire mediastinum. They are usually asymptomatic for a number of years, symptoms first developing in the third and fourth decades.

The cystic lymphangiomas, which are less common, are characterized by the formation of multiple cysts. The cysts may occur anywhere and histologic diagnosis is not possible before surgical removal or autopsy.

Pericardial cysts are simple thin-walled cysts located along the apex of the heart, usually asymptomatic.

Bronchial cysts are located in the posterior mediastinum and have a bronchial structure. They obstruct the air passages and produce symptoms early in life. They also cause dysphagia.

Gastric cysts reproduce the structure of the stomach. They may even have a peptic ulcer and 2 cases have been reported with rupture into the lung and fatal pulmonary hemorrhage. The contents can vary from a few to 400 c.c. of milky, clear, amber, or sanguineous fluid, which is either acid or neutral in reaction. These cysts are usually in the posterior mediastinum, behind the root of the lung. If fluid containing hydrochloric acid is aspirated, the diagnosis can be made.

Enteric cysts are very rare and cannot be differentiated clinically from bronchial and gastric cysts. All those reported have been found at autopsy in infants.

HAROLD O. PETERSON, M.D.

Pathology of Closed Injuries of the Chest. J. V. Wilson. Brit. M. J. **1:** 470–474, April 17, 1943.

The author gives a rather detailed discussion—based on postmortem studies—of closed chest injuries such

as are being encountered in the present war. His material is drawn from both military and civilian casualties.

The cases under discussion are divided into two main categories, those due to direct violence to the chest and those resulting from injuries elsewhere in the body. The first group includes lacerations, contusions, and blast injuries, and it is these with which this paper is chiefly concerned. Two cases of laceration due to explosions are presented, both illustrating the seriousness of the condition, which depends not so much on the actual lung injury as upon the development of complications. In both cases there were fractured ribs and a torn lung. Internal complications in this category are listed as pneumohemothorax, compression or collapse of the lung, and infection.

Under the heading of contusion it is pointed out that injuries to the heart by non-penetrating blows are commoner than is supposed. Trauma to the heart occurs either directly or as a feature of a blast injury. It may cause contusions of the myocardium, traumatic pericarditis, or rupture of the valves of the great vessels. Any part of the myocardium may be involved, but the anterior surface of the ventricles seems more often to be affected, the injury being frequently followed by local hemorrhage and eventual softening, which follows the same course as infarction. Traumatic pericarditis is rarely serious, and valvular injuries and rupture of the great vessels are not common. One case of pulmonary contusion is described in which direct trauma affecting the upper part of the lung caused hemorrhage throughout the lobe involved.

In blast injuries hemorrhagic areas are scattered throughout the lung, deep in its substance as well as subpleurally. Histologically the lungs of patients dying early show widespread congestion and intra-alveolar hemorrhage. Since changes may not be limited to the lungs, it is important that all cases of blast be examined with a consideration of cardiac symptoms also, as tachycardia, dilatation, and irregularity.

Pulmonary fat embolism is given as an example of chest injuries secondary to trauma elsewhere. It is usually a sequel to fracture of a long bone, notably the femur. Q. B. CORAY, M.D.

THE DIGESTIVE TRACT

Considerations on the Diagnosis of Large Gastric Ulcers and Implications as to Treatment. F. Steigmann. Am. J. Digest. Dis. **10:** 88–93, March 1943.

From a study of over 200 large gastric ulcers, the author has come to a realization that "there are no symptoms, signs, laboratory tests, x-ray or gastroscopic findings, which will determine the nature of a large gastric ulcer." X-ray findings are 95 per cent correct in the diagnosis of peptic ulcer, but in the case of large gastric ulcers, those thought by roentgenologists to be benign may be malignant and *vice versa*.

Checking on some current theories of diagnosis, Steigmann has found that duration of symptoms is not necessarily of diagnostic importance. The age of the patient is of little help. Eighty-two per cent of the patients having benign ulcers were over forty years of age and there were several instances of carcinoma below forty. Vomiting, weight loss, pain, blood in the stools could not be relied on for a differential diagnosis. Free acid was sometimes present in carcinoma of the stomach. Many patients having benign ulcers showed free acid below 20 degrees and only 30 per cent had a free acid value above 40 degrees.

The x-ray signs usually described as differentiating a benign from a malignant ulcer—namely, size (ulcers larger than a quarter being probably malignant), location, rugal pattern, an incisura opposite the ulcer, pylorospasm, pain on pressure—all fail as diagnostic criteria in the presence of a large gastric ulcer, mainly because of the distortion produced by the lesion.

It has been said that no criteria are pathognomonic of a benign lesion unless it be the roentgenologically and gastroscopically *observed* and *proved* complete healing of the ulcer. The author agrees with the first part of this statement but takes exception to the latter, reporting a case to prove his point.

JOSEPH T. DANZER, M.D.

Prolapsed Gastric Mucosa: Roentgenologic Demonstration of Ulcer Crater in Prolapsed Polypoid Mucosa. A. Melamed and R. I. Hiller. Am. J. Digest. Dis. **10:** 93–95, March 1943.

A case of prolapsed gastric mucosa with ulceration of the prolapsed portion was demonstrated by roentgen examination. The findings were proved at operation.

JOSEPH T. DANZER, M.D.

Jejunal Diverticula: Consideration of Clinical Symptomatology and Case Report. A. C. Van Ravenswaay and G. W. Winn. Am. J. Digest. Dis. **10:** 108–111, March 1943.

According to Johns, writing in 1937 (South. Med. & Surg. J. **99:** 265, 1937), there had then been recorded in the literature only 26 cases of jejunal diverticulum discovered by x-ray examination, of which 17 had been verified at operation.

The cause of these diverticula is not known, some appear in young infants, indicating the probability of a congenital origin. Those seen in later life are thought to be due to a congenital or acquired weakness of the abdominal wall. The symptoms resulting from distention of the sac are usually described as a feeling of fullness, although there may be dull or acute pain and localized tenderness. Acute jejunal diverticulitis i prone to lead to gangrene and rupture, and unless there is prompt surgical intervention fatal termination may be anticipated.

A case is reported. JOSEPH T. DANZER, M.D.

Bleeding Associated with Extramucosal Tumors of the Stomach. O. D. Sahler, and A. O. Hampton. Am. J. Roentgenol. **49:** 442–449, April 1943.

The term "extramucosal tumors of the stomach" is used to include a large variety of histopathologically different tumors, including leiomyoma, fibroma, neuroma, hemangioma, aberrant pancreatic tissue, and the malignant forms of some of these lesions. On roentgen examination these tumors must be differentiated from cancer and benign polyps. Differentiation from cancer depends upon the relative normality of the adjacent mucosa, the sharpness and smoothness of outline, and the angle formed at the gastric wall junction, which is usually obtuse, though it may be acute. The most common distinguishing feature in differentiation from polyps is that these tumors are usually sessile, whereas polyps are often pedunculated. Additionally, the contour of the extramucosal tumors is relatively smooth as contrasted with the more lobulated appearance of

polyps; ulceration of the deep type may be present on the surface. The presence of a pancreatic "arrest" in the stomach wall is confusing, as the appearance may be very similar to that of other extramucosal tumors. Since pancreatic "arrests" do not bleed, the occurrence of bleeding would favor the diagnosis of other submucosal tumors.

In the past 27 years, 24 intramural tumors of the stomach have been removed surgically at the Massachusetts General Hospital; in 21 of these, fairly adequate roentgen examination was done. Sixteen patients gave a positive history of bleeding. Of the 21 cases examined roentgenologically, 20 showed a definite filling defect which was described as round, smooth, or lobulated; 9 showed ulceration. In one patient the tumor was not demonstrated roentgenologically. Two cases of ectopic pancreas were seen. Both of these showed a smooth rounded defect in the stomach, with a central dimple. This dimple represented the lumen of the duct for the aberrant pancreatic tissue and not an ulcer crater. The pathological diagnosis in the entire group of 20 cases was as follows: leiomyoma, 8; leiomyosarcoma, 6; neurofibrosarcoma, 4; neurofibroma, 2; sarcoma, 2; fibrosarcoma, 2; fibroma, 1.

L. W. PAUL, M.D.

Bleeding in Hiatus Hernia. O. D. Sahler and A. O. Hampton. Am. J. Roentgenol. **49:** 433–441, April 1943.

Between 1930 and 1940, 221 cases of hiatus hernia were reported in the Department of Radiology of the Massachusetts General Hospital. This figure, however, does not represent the total number of patients with hiatus hernia, for in many cases the examiner did not regard such herniae of sufficient significance to record them. An analysis of the 221 recorded cases was made with special attention to the incidence of bleeding. Thirty-two patients had either moderately marked anemia or a positive history of gastro-intestinal tract bleeding; 19 of these gave a history of hematemesis, while 5 others had gastro-intestinal tract hemorrhage without hematemesis. In 10 of the 19 cases with hematemesis there was evidence of either gastritis or ulceration as determined by roentgenography, gastroscopy, or postmortem examination.

In order to determine the incidence of hiatus herniae, 100 consecutive clinic patients were examined during a two-month period. Each was examined in both the upright and horizontal position, with the esophagus filled with barium and in both the right and left oblique positions. Among this group, 9 cases of hernia were found, in 3 of which there was a history of having vomited small amounts of blood. It is the authors' opinion that many hiatus herniae will not be demonstrated if the supine and prone examinations are omitted. When a hernia is present, examination in the right anterior oblique position with the patient supine, and with the esophagus filled, will demonstrate the narrowing produced by the cardiac sphincter above the herniated fundus. The constriction of the fundus is evident as it passes through the diaphragm, as is the gastric mucosa. If the patient is turned to the left anterior oblique position, the esophagus is seen to enter at the right anterior margin of the herniated fundus. This asymmetry of the relation of the esophagus with the collection of barium above the diaphragm is of considerable importance in establishing the diagnosis. Care must be taken not to confuse dilatation of the lower end of the esophagus during peristalsis with a hiatus hernia. If the facts mentioned above are kept in mind, no confusion will arise. In a rare case the actual hernial sac may be seen in the lower mediastinum as a soft tissue mass, fusiform in shape and smooth in outline.

Bleeding, when present, particularly hematemesis, may be due to the hernia, as a result of congestion of the blood vessels in the herniated portion of the stomach, with a resultant gastritis or ulceration.

L. W. PAUL, M.D.

Primary Carcinoma of the Duodenum. L. Berger and H. Koppelman. Ann. Surg. **116:** 738–750, November 1942.

This paper is essentially a review and analysis of the literature dealing with all types of primary carcinoma of the duodenum. Each group is discussed from the standpoint of incidence, symptomatology, roentgenographic findings, pathologic picture, and recorded surgical results. In addition, the authors present a proved case of infrapapillary carcinoma of the duodenum.

Primary carcinoma of the duodenum is subdivided into suprapapillary, peripapillary, and infrapapillary types. The suprapapillary is that portion of the duodenum lying above the common duct opening and is derived from the foregut. The infrapapillary portion arises from midgut, while the papillary region is the zone between these two. Carcinoma in this last area may arise from the duodenum, ampulla of Vater, terminal bile duct, or terminal pancreatic duct; in the other areas it arises solely from the duodenal mucosa. In a review of the literature the authors found only 386 authentically proved cases of carcinoma of the duodenum reported up to the date of their paper. Of these, 65 per cent were peripapillary, 20 per cent suprapapillary, and 15 per cent infrapapillary. The over-all incidence is from 0.03 to 0.003 per cent of all autopsies, or in other words from one case in 3,000 to one in 30,000 autopsies. Hoffman and Pack estimate that duodenal carcinoma comprises 0.3 per cent of all intestinal carcinomas. Most cases occur in the sixth decade of life and males predominate.

Duodenal obstruction of varying degrees accounts for the chief symptoms in all malignant tumors of the duodenum. In the suprapapillary group the onset is acute in one-half of the cases, with vomiting, epigastric pain, weakness, weight loss, and later jaundice and dyspepsia. If the onset is more gradual, pain, dyspepsia, and weight loss are the most prominent symptoms. Of the 77 cases reported only 2 were correctly diagnosed preoperatively, and these from the roentgenograms.

In the peripapillary type the predominating symptom or sign is the early development of obstructive jaundice. This was acute in 80 per cent and was present in 99 per cent of the recorded cases. Pain, weight loss, anorexia, vomiting, constipation, and diarrhea were the accompanying symptoms in the order of frequency. A correct preoperative diagnosis was made in 20 per cent of the cases and roentgenographically suspected in 25 per cent.

In the infrapapillary group the principal symptoms are pain, vomiting, and cachexia, while constipation, diarrhea, anorexia, and jaundice are less common. In a series of 15 cases studied roentgenographically by Lieber, Stewart, and Lund, an obstructing lesion of the

duodenum was present in 40 per cent; in 27 per cent no lesion was demonstrated, while in 33 per cent the lesion was diagnosed as at, or near, the pylorus.

The authors' reported case was an infrapapillary carcinoma. The correct diagnosis was not made preoperatively and at operation, although a generalized carcinomatosis was revealed, no intrinsic lesion was discovered. At necropsy the primary site was found in the infrapapillary portion of the duodenum. Review of the roentgenograms showed a Y-shaped filling defect in the distal duodenum which had previously been overlooked. In the review of the literature the authors found similar diagnostic errors. These they believe are due partly to the vague and obscure symptoms often accompanying carcinoma of the duodenum, but chiefly to the fact that duodenal carcinoma, because of its rarity, is usually not consciously considered.

In conclusion the authors point out that, although the results of radical surgery so far have been discouraging (5.2 per cent five-year cures), with earlier diagnosis and with improved methods of preoperative and postoperative care, the future should show improvement.

P. C. BRIEDE, M.D.

Primary Carcinoma of the Infra-Ampullary Portion of the Duodenum, with Example of Probable Origin from Aberrant Pancreatic Tissue. G. L. Duff, H. L. Foster, and W. W. Bryan. Arch. Surg. **46:** 494–503, April 1943.

Carcinoma of the duodenum is usually classified as supra-ampullary, peri-ampullary, and infra-ampullary. In any location it is rare, constituting only about 0.3 per cent of all intestinal cancers. Typically the patient complains of epigastric distress, usually aggravated by food and relieved by vomiting. There may also be a history of anorexia, weight loss, or alternating diarrhea and constipation. An epigastric mass and occult blood in the feces may be present. The period of illness before a physician is consulted is usually three to eighteen months; men are more commonly afflicted, and the age incidence lies in the fourth decade and thereafter. The condition has seldom been correctly diagnosed roentgenologically, but careful attention to the changes present should make the diagnosis possible.

A case of carcinoma of the infra-ampullary portion of the duodenum in a 35-year-old man is reported. The symptoms were classical. Roentgenologically there was an irregular tender narrowing of the duodenum just distal to the junction of the second and third portions, with a persistent fleck in the narrowed channel. At four hours 60 per cent of the barium meal remained in the stomach. After exploratory laparotomy, at which numerous metastases were found, the patient followed a downhill course and died. Autopsy showed that the tumor arose in aberrant pancreatic tissue.

Since the x-ray signs are typical, they should lead to a correct diagnosis in most instances. Sarcoma cannot be distinguished from carcinoma by x-ray examination.

LEWIS G. JACOBS, M.D.

Enteric Intussusception in Adults. W. H. Gerwig, Jr., and H. B. Stone. Surg., Gynec. & Obst. **76:** 95–99, January 1943.

A rather unusual case of adult jejunal intussusception is presented. The patient had, in addition, a polyposis involving both the large and small intestines.

A 25-year-old male was admitted to the Station Hospital, Fort Meade, Maryland, Jan. 10, 1941, complaining of pain in the abdomen and across the lumbar region. Six years previously, he had suffered an attack of pain in the rectum, associated with bleeding, a constant desire to defecate, and a mass protruding from the anus. At that time a polyp with a long pedicle was removed. Four years later another polyp was removed. Twenty days before his admission to the Station Hospital at Fort Meade, the patient had a sudden attack of severe lower abdominal pain which gradually subsided but was followed by recurrent nausea. On Jan. 6 nausea, vomiting, abdominal cramps, and backache occurred and on the following day there was frequency of urination and the pain in the back became more severe.

Examination, on admission, showed tenderness over both kidneys. The abdomen was mildly distended, with no rigidity or local tenderness. Rectal examination was negative, as was a spot film of the abdomen. The original impression was perirenal abscess. On Jan. 11 the patient experienced extreme sharp pain in the abdomen and vomited dark brown fluid containing blood. Abdominal distention was increased and the pain now centered around the umbilicus rather than in the renal region. Peristalsis was audible. A diagnosis of acute intestinal obstruction was made.

On opening the abdomen, a hard mass was found lying in the pelvis. This proved to be a gangrenous, irreducible intussusception involving about 2 1/2 feet of the jejunum. A resection of the mass was carried out and an end-to-end anastomosis was performed. Hurried examination of the adjacent bowel revealed no palpable polyps.

Four weeks following the operation, while the patient was at stool, a small mass attached by a long narrow pedicle passed the anus. The pedicle was ligated and cut. After several weeks' convalescence a careful survey was begun. Repeated proctoscopic examinations were negative, and no information was obtained from two barium enemas. Eventually films made with the aid of a double contrast barium enema revealed several large polyps located in the region of the splenic flexure and sigmoid.

At operation one polyp, located 12 inches proximal to the original anastomosis, was removed. Five polyps were felt in the region of the splenic flexure and a resection of this area was carried out; it contained, in addition, numerous small polyps which were not palpable. Microscopic sections revealed a characteristic type of adenomatous polyp. One of these multiple lesions had probably caused the acute jejunal intussusception.

A general discussion of intussusception is included and special emphasis is placed on the necessity for location and removal of the organic etiological agent which is so frequently present in adults.

Syndrome of Symptomatic Sprue in Lymphosarcomatosis of the Small Bowel and of the Mesenteric Lymph Nodes. Robert Fritzsche. Schweiz. med. Wchnschr. **73:** 442–445, April 10, 1943.

Sprue is to be differentiated (according to Markoff: Helvet. med. acta (Supp. III) **5**: 3–48, 1938) from steatorrhea, pernicious anemia with pancreatic damage, achylia pancreatica, acholic steatorrhea, mesenteric lymph node tuberculosis, intestinal tuberculosis, amy-

loid disease of the bowel, and gastrocolic fistula. These conditions lead to what may be called symptomatic sprue. A case of this type, due to lymphosarcomatosis, is reported.

A man 45 years old, accepted as healthy for military service in October 1939, began the following November to have abdominal pain and at times obstipation. In January 1940 a diagnosis of neoplasm was made. Examination revealed slight enlargement of the axillary and supraclavicular lymph nodes, but no other abnormality. There was a severe steatorrhea. Roentgenologic studies showed a dilatation of the small bowel with delay in the passage of the test meal, clumping of the barium, and loss of mucosal pattern. There was abnormally fast emptying of the colon. A diagnosis of severe jejunitis and colitis was made. Necropsy (April 1940) demonstrated an extensive lymphosarcomatosis (lymphoblastic type) of the jejunum, ileum, and mesenteric nodes. LEWIS G. JACOBS, M.D.

THE BILIARY TRACT

Diverticulum of the Gall Bladder: Review of the Literature and Report of a Case. M. Golob. Am. J. Digest. Dis. **10:** 148–151, April 1943.

The author describes what he believes is a diverticulum of the gallbladder, basing this belief on two different cholecystograms, reproductions of which illustrate his article. No attempt was made to take a lateral view or an examination in the standing position. The diagnosis was not verified by operation.

JOSEPH T. DANZER, M.D.

THE SPLEEN

Cysts of the Spleen. M. Paul. Brit. J. Surg. **30:** 336–339, April 1943.

The *Echinococcus granulosus* is the only parasite giving rise to cysts in the spleen. Multiple cysts of the spleen are occasionally seen in cases of polycystic disease of the kidneys. Other splenic cysts fall into two main classes: large single cysts and multiple cysts. The large single cyst constitutes 80 per cent of the nonparasitic cysts. These cysts are of 3 types: (1) the dermoid cyst, which is very rare and probably due to epithelial cell inclusion; (2) cysts containing blood or altered blood, arising from intrasplenic hemorrhage; (3) epidermoid cysts, which do not contain sebaceous material or hair. These cysts contain a thin brown fluid, glistening from its content of cholesterin crystals. Outside the incomplete cellular lining of the cyst is a layer of firm laminated hyalinized fibrous tissue. The multiple serous cysts have an endothelial lining.

The symptoms produced by the large single cyst are due entirely to pressure on surrounding organs. X-ray examination after a barium meal will demonstrate a displacement of the esophagus and stomach to the right and a downward displacement of the splenic flexure. Splenectomy is the best treatment.

The author reports a case of a girl aged 19 with a mass in the left upper abdomen which grew progressively larger over a period of one year. Examination revealed a large fluctuating mass in the upper left abdomen extending from the costal margin to the level of the umbilicus. Roentgen examination after a barium meal showed the stomach lying vertically, to the right of the spine. At operation a large splenic cyst was found, occupying the whole left hypochondrium and epigastrium. The cyst contained a thin brown fluid, microscopic examination of which revealed red blood cells and cholesterin crystals. The cyst wall on section showed hyalinized fibrous tissue containing several cystic spaces lined by stratified epithelium. In view of a past history of malarial fever the origin of the cyst was attributed to an old intrasplenic hemorrhage. While the cyst in this instance was obviously of the solitary serous variety, the microscopic cystic spaces discovered in the wall suggest a transition stage to multiple serous cysts.

MAX CLIMAN, M.D.

SUBPHRENIC ABSCESS

Left Subphrenic Abscess. H. Neuhof and N. C. Schlossmann. Surg., Gynec. & Obst. **75:** 751–758, December 1942.

This presentation is based on a study of 33 cases of left subphrenic abscess observed at Mount Sinai Hospital from 1928 to 1942; 51 cases of right subphrenic abscess were observed in the same period. The authors point out the decided differences in the anatomical, pathological, and clinical features of right and left subphrenic abscess and mention the disparity in mortality in their series: 35 per cent for right subphrenic abscess as compared with 75 per cent for left subphrenic abscess. The various organs bordering the left subphrenic space, and their mobility, render more complex the problem of diagnosis and treatment of left subphrenic abscess, as compared with the right.

All left subphrenic abscesses in the Mount Sinai series were secondary to intra-abdominal suppurative foci. Direct extension of infection from nearby organs was by far the most frequent mode of spread. The most frequent single source of infection was the stomach or duodenum (13 cases). Lymphatic dissemination played scarcely any role.

Clinical manifestations of left subphrenic abscess, usually vague and sparse, often appeared relatively late in the course of the disease. Indirect evidence of thoracico-abdominal manifestations was usually more significant than direct signs of a subphrenic abscess. An elevated, paralyzed diaphragm, a characteristic finding in right subphrenic abscess, was demonstrable in only 18 of 30 cases of left subphrenic abscess. The rise of the diaphragm in left subphrenic abscess may be masked, in the customary postero-anterior film, by supradiaphragmatic effusion. Lateral and oblique views may resolve difficulties in interpretation. Careful study of roentgenograms may offer the only basis for the correct diagnosis, as well as for a precise surgical approach to a left subphrenic abscess of the thoracic type. Varying degrees of pleural effusion so overshadowed the diaphragm in 7 instances that its position was completely masked in repeated roentgenograms. In some cases it may be necessary to ascertain the relationship between the stomach and diaphragm by the administration of medication producing gas in the stomach (Seidlitz powder, bicarbonate of soda). Exploratory aspiration is often imperative in order to establish the diagnosis.

In the operative treatment of left subphrenic abscess, a subpleural approach is advocated for abscesses of the "abdominal" type; a transpleural transdiaphragmatic approach for the "thoracic" type. A satisfactory one-stage transpleural transdiaphragmatic operation is described with a double sealing of the free pleura by two tiers of diaphragmatic sutures.

THE SKELETAL SYSTEM

Avascular Necrosis of Bone. J. F. Brailsford. J. Bone & Joint Surg. **25:** 249–260, April 1943.

An earlier study of 33 cases of Legg's disease followed by serial films led the author to recommend immobilization for a long period as the method of choice in the treatment of this condition. In 1932 he showed before the Medical Society of London (Trans. M. Soc. London **55:** 251, 1932) roentgenograms demonstrating that for upward of four years the bone of the affected joint is plastic and easily deformed by pressure; if, however, the joint is immobilized during the plastic stage deformity does not occur. Further studies led in 1934 to a tabulation showing the various stages of the disease from its inception to complete healing. For the first two or three months, the bone is becoming plastic and there is (1) increased density of the femoral capital epiphysis; (2) relative increase in joint space; (3) osteoporosis of the diaphysis. In the next three to eighteen months, the bone is plastic and there are (4) compression and impression fractures of the epiphysis; (5) appearance of fragmentation; (6) compression and flattening of fragments; (7) gradual absorption of dense fragments; (8) compression and expansion of the proximal end of the diaphysis. In the next period—one and a half to four years—the bone is still plastic and the (9) first appearance of regeneration in the epiphysis is seen as absorption of the dense fragments; (10) appearance of circumscribed osteoporosis; (11) increased deposition of calcium and obliteration of the osteoporotic zone in the diaphysis. In and after the fourth year consolidation takes place and (12) the roentgenographic appearance becomes that of normal bone.

It has been held that Legg's disease is not an osteochondritis but simply an avascular necrosis; also that osteochondritis and avascular necrosis are one and the same condition. The author believes, however, that osteochondritis embraces "the more important concomitant living process," producing calcification and plasticity in the neighboring bone, permitting deformity when pressure is applied.

The roentgen changes are not identical with those following surgical trauma in the reduction of congenital dislocation of the femoral head, fractures of the femoral neck, or displacement of the femoral diaphysis from the capital epiphysis, though avascular necrosis may occur in these conditions. After vigorous attempts to reduce a *congenital dislocation*, there may be fragmentation of the femoral head, but here the fragmentation occurs in the regenerative phase and resembles ossification of the femoral head as seen in hypothyroidism. Also the process is more rapid than in Legg's disease and there may be severe damage to the growth cartilage, with consequent stunting of growth. Healing of a *slipped epiphysis* is associated with fusion of the epiphysis and diaphysis, which is not observed in Legg's disease. The mass necrosis of the femoral head and the pressure deformities of the femoral neck which occur in some cases present quite a different picture. *Fractures of the femoral neck* in children may show vascular changes. On the initial examination, there will be no difference in density of the fragments, but after a month or so some cases will show decalcification distal to the fracture while the proximal fragment appears increasingly dense, indicating interference with the blood supply here. Unless the fragments are immobilized at this time a coxa vara deformity will develop. If avascular necrosis occurs, complete recovery may be delayed for several years.

Following a dislocation of the hip joint the femoral head may undergo avascular necrosis, due to interference with the blood supply in the production or reduction of the dislocation. It is unusual for fractures of the acetabulum to be followed by avascular necrosis of the femoral head.

Osteochondritis dissecans may occur in the femoral head. This the author believes to be due to injury of a localized segment of articular cartilage with permeation of synovial fluid which inhibits fusion. When the fragment becomes necrotic or displaced, symptoms develop.

The characteristic of necrotic bone is hypercalcification which is determined by comparison with the same portion of the opposite bone. Plasticity is another characteristic. However, not all areas of hypercalcification are due to avascular necrosis. The necrotic bone will gradually lose its density as it becomes infiltrated with living cells.

In cases of fracture of the femoral neck where the fragments have been pinned, necrosis may occur after two or three months. If weight-bearing is permitted, deformity and disability will occur. It is well, therefore, to keep the patient in bed for two or three months, when a roentgenogram will indicate whether the vascularity has been disturbed and whether or not union will occur. JOHN B. MCANENY, M.D.

Post-Traumatic Dystrophy of the Extremities: A Chronic Vasodilator Mechanism. Géza de Takáts and D. S. Miller. Arch. Surg. **46:** 469–479, April 1943.

Post-traumatic bone dystrophy, or Sudeck's atrophy, is characterized in its early stage by severe, persistent, burning paroxysms of pain in a patient whose limb is properly immobilized, non-infected, and seemingly on the way to normal repair. In this stage the extremity is warm, the subcutaneous tissues and the periarticular spaces are edematous, and the muscles hypertonic. Pain is closely limited to the site of injury and there is no osteoporosis, which does not develop unless there has been hyperemia of four to eight weeks' duration. The syndrome may cease at this stage, or may progress to the second stage, in which the periarticular edema is more diffuse and the limb becomes hard, cyanotic, and cold. The joints become stiff rather early, and the pain resembles a spreading neuralgia. Finally, the skin becomes atrophic, the muscles atrophic, and osteoporosis appears, at first in a localized spotty fashion but later diffusely. There is nothing particularly characteristic about the osteoporosis, and it is doubtful if the diagnosis could be made from roentgenograms alone. The pain does not parallel the degree of osteoporosis.

Repeated plethysmographic studies, made in 12 of a series of 33 patients studied by the authors, showed an increased blood flow to the affected limb. Blood calcium and phosphorus levels were normal, but blood phosphatase was usually slightly increased.

Mild cases may subside spontaneously or yield promptly to paravertebral infiltration of procaine hydrochloride. In the more severe cases, though the course is self-limited and spontaneous healing normally occurs in a year, there are residual stiffness, deformity, and contractures. Functional and economic rehabilitation is hardly ever obtained. The condition seldom follows severe injuries and seems to be facilitated by

emotional factors. It is caused by a reflex vasodilation produced by sensory reflexes through the spinal cord.

If the syndrome is recognized in the first few weeks, repeated block of the local area and immobilization may abort the disease. Repeated paravertebral injections of procaine, each giving a longer period of relief, may be needed. If the relief is short-lived and symptoms recur promptly, periarterial sympathectomy should not be delayed. In some cases with severe intractable symptoms in association with compensation neurosis, drug addiction, or mental imbalance, no therapy is successful. Orthopedic correction may be needed in the presence of advanced atrophy after the pain has subsided.

LEWIS G. JACOBS, M.D.

Familial Vertebral Dystrophy: Case Reports. M. Halberstaedter. Brit. J. Radiol. **16:** 121–124. April 1943.

Two brothers, 39 and 35 years of age, showed the same spinal defects. One sister and another brother were normal. Apart from the spinal defects there were no other abnormalities.

In both patients there were disproportionate shortness of the trunk, spinal rigidity, and dorsal scoliosis. The cervical spine was normal. The dorsal spine showed flattening and elongation of the vertebral bodies. In the case of the older there was some wedging, with secondary lipping of the anterior margins. There was a slight decrease in the intervertebral spaces. Some nuclei pulposi showed calcification. The upper and lower margins of the bodies were ill-defined and irregular, with notching just behind the anterior margin on the upper surface. The changes were less marked in the lumbar region. The pelvis in each case was slightly reduced in size.

The flattening and deformity of the vertebrae, the changes in the pelvis, and the absence of other bony defects classify this condition as Type C of Brailsford's chondro-osteo-dystrophy.

SYDNEY J. HAWLEY, M.D.

Epiphyseal Dysplasia Punctata in a Mother and Identical Male Twins. E. Resnik. J. Bone & Joint Surg. **25:** 461–468, April 1943.

Because epiphyseal dysplasia has been considered to be due to thyroid hypofunction, the author presents the cases of a mother and her twin sons, who were followed from birth to puberty. In none of the three patients was there definite evidence of hypothyroidism, though the children showed a delay in bone age as compared to chronological age.

The mother had multiple osteochondritis diagnosed roentgenographically at the age of six. The early roentgenograms were not available, but more recent ones showed flattening of both femoral heads, foreshortening of the femoral necks, and upward displacement of the femoral shafts. Characteristic changes were present, also, in the humeral heads and in the bones of the hands.

The twins were delivered by cesarean section. At the age of ten one was found to have an aseptic necrosis of the capital epiphysis of the left femur. Under treatment (traction) complete regeneration took place. In the other twin pain and disability in the right hip occurred somewhat earlier. Roentgenograms showed flattening, fragmentation and increased density of the capital epiphysis. Response to treatment was less satisfactory than in his brother. In both boys the humeral heads were stippled, the interphalangeal joints showed cupping and trumpeting, and there was evidence of irregular calcification in the epiphyses of the long bones.

JOHN B. MCANENY, M.D.

A Prenatal Diagnosis of Osteopetrosis. E. L. Jenkinson, W. H. Pfisterer, K. K. Latteier, and Mary Martin. Am. J. Roentgenol. **49:** 455–462, April 1943.

An interesting case is reported in which a prenatal diagnosis of osteopetrosis was made. Films made in the sixth month of pregnancy revealed a small fetal skeleton with all of the bones unusually dense and widened. One week following the roentgen examination, the pregnancy was terminated and a macerated fetus delivered. Complete roentgenographic and pathologic study of the fetal skeleton was made, confirming the prenatal impression of osteopetrosis. The chief roentgenologic changes are listed as follows: increased density of practically all of the bones; widening of all of the long bones, especially the tibiae and ulnae; fine mottling of the long bones; narrowed medullary cavity; thickening of the cortex; no periosteal thickening; great density of the base of the skull; increased striae in parietal, frontal, and occipital bones; calcification of the kidneys; absence of periosseous thickening. The histopathological findings are described in detail.

In differential diagnosis congenital syphilis offers the greatest problem. Syphilis, however, unlike osteopetrosis, rarely attacks the bones of the base of the skull. Serological studies are very important in the differentiation from syphilis. Other lesions must also be considered. In leukemia the changes are predominantly destructive rather than proliferative, and when sclerosis does appear, it is less generalized. Chronic fluorine poisoning may present changes similar to those of osteopetrosis. Here the history is of great importance. The adjacent soft tissues may show osteophyte formation with calcification of the ligaments and with periosseous deposits. In older patients Paget's disease may present a problem, but the changes in the skull, pelvis, and long bones are usually quite characteristic, and the trabeculae, instead of being absent, are prominent and thickened. Chronic metallic poisoning such as lead or phosphorus poisoning, may be excluded by the history, chemical analysis, and examination of the red blood cells.

This case and others recorded in the literature are evidences that osteopetrosis undoubtedly originates *in utero* but it is not uncommon for patients suffering from this disorder to reach adult life.

L. W. PAUL, M.D.

Sciatica and the Mechanism of the Production of the Clinical Syndrome in Protrusions of the Lumbar Intervertebral Discs. J. E. A. O'Connell. Brit. J. Surg. **30:** 315–327, April 1943.

The purpose of this comprehensive paper is to describe the typical syndrome of the lower lumbar intervertebral disk protrusions and the mechanism by which disk protrusions give rise to symptoms. The clinical observations were made on a series of more than 75 cases proved by operation, and only the disks between the 4th and 5th lumbar vertebrae and the 5th lumbar and sacrum are considered. The history is very important and the author stresses the distribu-

tion and type of pain, intermittency of symptoms, and paresthesiae. In more than half the cases there is a history of a definite injury which immediately, or within a short period, precipitated the pain. Examination of the spine reveals some deformity in a high proportion of cases. There may be a loss of the normal lumbar lordosis and a lateral tilt. Percussion in the lower lumbar and sacral areas may produce an exacerbation of the sciatic pain and at times paresthesiae in the areas in which they have previously been felt spontaneously. The importance of the straight leg-raising test—Lasègue's sign—is widely recognized. The author employs a modification of this test which consists of flexing both legs simultaneously. It will frequently be found that the angle of flexion permitted is greater than that allowed when the affected limb is flexed alone. After flexion of both straight legs to an angle just short of producing pain, lowering the sound limb will result in severe exacerbation of the sciatic pain. Flexion of the neck will produce the same result.

Radiographic examination is considered of little importance. Plain films of the lumbosacral region are made to exclude gross bone disease and to detect congenital variations. At times a narrowing of the affected disk may be demonstrated associated with lipping of the vertebral margins.

Lumbar puncture does not give much aid in the diagnosis of protrusion of a lumbar disk and was not performed in the later cases of this series.

The essential factor in the production of symptoms is believed to be the stretching of an intraspinal nerve in its extradural portion over or around the mass of protruded disk tissue. The *intradural* nerve roots in the lower regions of the spinal canal lie loosely and are not likely to be affected to the point of causing symptoms. The *extradural* portion of the spinal nerves is by comparison relatively fixed and immobile. Consequently slight pressure exerted against such an area may produce pain. Experimental work on cadavers revealed that the degree of tension in the intraspinal roots varied with the movements of the spine and limbs.

Several clinical signs of disk protrusions are considered in the light of the tension hypothesis. The obliteration of the lordosis is a mechanism which relieves tension in the sciatic nerve roots and thus diminishes discomfort. The same conditions apply to the scoliosis, which is usually toward the affected limb. The important straight leg-raising test is also explained on the basis of the tension hypothesis. The increase in tension which develops in the extradural roots as this movement is carried out will produce an exacerbation of the pain when the painful leg is tested.

MAX CLIMAN, M.D.

Disseminated (Miliary) Tuberculosis of Bone With Multiple Localizations in the Skeleton: Report of Two Proved Cases. John Lyford III. J. Bone & Joint Surg. **25:** 453–460, April 1943.

The author gives two complete case histories of disseminated tuberculosis of bone, with foci in the bones of the trunk but no evidence of involvement of the hands or feet, distinguishing these cases from the osteitis tuberculosa multiplex cystica of Jüngling.

Both cases were chronic without lung or joint involvement. Trauma seemed to be the exciting cause in each. In one case the lesions were sclerotic without sinus formation. The other was caseous in nature, with multiple abscess and sinus formation.

In patients with multiple bone lesions, tuberculosis must always be considered in the differential diagnosis; its presence can be confirmed only by biopsy.

JOHN B. MCANENY, M.D.

Bridging of the Vertebral Bodies in Tuberculosis of the Spine. R. Perlman and J. A. Freiberg. J. Bone & Joint Surg. **25:** 340–350, April 1943.

This is a report of 5 cases of proved tuberculosis of the spine in which bridging over the involved area occurred. All cases showed psoas abscesses. Bridging in the spine is usually considered to be due to pyogenic infection but none of these cases could be attributed to that cause. In four of the five cases bridging was considered adequate and surgical intervention was unnecessary. Much space is given to the discussion of whether tuberculosis of the spine occurs primarily in the disk, but the question remains unanswered.

JOHN B. MCANENY, M.D.

Tuberculosis of the Ankle Joint: End-Result Study of Twenty-Five Cases. S. S. Houkom. Surg., Gynec. & Obst. **76:** 438–443, April 1943.

Surgical fusion is the treatment of choice for tuberculosis of the ankle joint at the New York Orthopaedic Hospital, and this is done as soon as the positive diagnosis is made and the patient is in physical shape for operation. This article presents a series of 25 consecutive cases treated by this method.

The age of onset varied from fourteen months to forty-five years, and the symptoms at the time of original examination were the usual ones of pain, swelling, fluctuation, heat, muscle spasm, limitation of motion, equinus deformity, sinuses, and a unilateral limp. Their duration was from six weeks to twenty-six years. Twenty-one of the patients had had previous treatment of various types. The diagnosis was made on the basis of the clinical, x-ray, and laboratory findings, and confirmed at operation.

When these ankles are fused, great care is taken to secure apposition of the raw bleeding bone surfaces. The foot is fixed in dorsiflexion of 100 to 110 degrees. In the group under consideration 16 patients required only one fusion operation, but 3 of these required additional fusion of the talocalcaneal joint for a stable foot. Four required two operations, 3 required three operations, and 2 patients required five operations each. The one possible unfavorable aspect of this method of treatment is the chance of dissemination of the infection to the talocalcaneal joint. It is possible that this occurred in 4 of these cases.

A walking cast is applied after about six weeks in a long leg cast, and if at the end of seven or eight months there is unsatisfactory evidence of fusion, refusion is usually carried out. The average period of disability in these patients was 1.2 years and ranged from three months to five years, as contrasted with 4.7 years with conservative methods of treatment. In 16 patients the result is classed as excellent, in 6 good, and in 3 fair. The gait following successful fusion is excellent.

The roentgenograms illustrating this paper are most satisfactory.

JOHN O. LAFFERTY, M.D.

Congenital Dislocation of the Hip. H. Platt. Brit. J. Surg. **30:** 291–304, April 1943.

This paper, the Robert Jones Memorial Lecture delivered before The Royal College of Surgeons, opens

with a short biography and splendid tribute to the work of that great surgeon. The observations here recorded are based on the author's series of 349 cases covering a period of twenty-seven years.

The reduction of a congenital hip dislocation by manipulation followed by a period of fixation in plaster of Paris is still the method of choice. The author was able to re-examine 50 patients (62 hip joints) ten years or more after reduction; 46 of the 62 joints showed good or excellent function but a good or satisfactory *anatomical* result was obtained in only 29 instances. Among the causes of failure are anomalies of the joint capsule—such as attachment of the capsule to the femoral head, adherence of the capsule to the socket floor, or an abnormally developed limbus—which may prevent reposition of the femoral head into the depth of the socket; also skeletal anomalies, such as excessive anteversion of the femoral neck and failure of the acetabular roof to develop. The rare complication of osteochondritis is another unfavorable factor.

The indications for open operation are as follows: (1) as a primary operation in certain dislocations in young children during the favorable age period, when there is evidence that the intrinsic obstacles to reduction are formidable; (2) in older children beyond the favorable age period, where closed reduction is obviously impractical or too dangerous; (3) in residual subluxation following closed reduction in older children. Good anatomical and functional results cannot, of course, be guaranteed in hip joints already damaged by repeated unsuccessful efforts to reduce the dislocation by manipulation. The operation requires considerable accuracy of technic and it is important to preserve the ligamentum teres with its potentially important arterial supply to the head of the femur. Weight-bearing is not permitted until there is radiographic evidence that no growth disturbance has been set up in the femoral head or socket.

In infants in the first year of life treatment consists in gradual abduction and involves the use of an apparatus known as a divaricator, on which the baby is fixed and from which it is removed at regular times for washing and nursing. Complete reduction is obtained after some weeks or even months. In Bologna, where this method originated, 94 per cent of a large series of cases thus treated showed excellent results. The author has used the method in only 13 cases. In 4 it was discontinued because of the inconvenience; in 1 it was a complete failure; in 8 the results were excellent. Two patients were still under treatment.

MAX CLIMAN, M.D.

Tangential Osteochondral Fracture of the Patella. J. E. Milgram. J. Bone & Joint Surgery. **25:** 271–280, April 1943.

This presentation is made to bring attention to osteochondral fractures of the patella, that they may be recognized promptly, differentiated from the degenerative type of osteochondritis dissecans, and brought to early operation.

The usual story is that a child or young adult twists the knee; a loud noise, sudden pain, and possibly lateral dislocation of the patella occur. Hydrarthrosis and disability follow. Later a free body is found within the joint. If operation is performed early, it will be found that a piece of cartilage has been avulsed from the articular surface of the patella, usually in the medial inferior quadrant.

Four full case reports are presented, as are also roentgenograms and photographs of gross and microscopic specimens.

JOHN B. MCANENY, M.D.

Case of Insufficiency Fracture Occurring in the Neck of the Femur. R. L. Mansi. Brit. J. Radiol. **16:** 119–120, April 1943.

So-called "insufficiency" or "fatigue" fracture is frequently found in service men, and may readily be overlooked, as there is no history of trauma.

The author's patient was a 19-year-old signalman, with no history of injury. His first complaint was slight pain in the right hip on walking. After five days this became so severe that he had to be excused from drill. He was treated for four days by rest and massage, but the pain persisted. On x-ray examination a fine fissure was observed on the inner side of the middle of the neck of the right femur. Six weeks later the fracture line had extended across the neck and was practically healed in good position. During the six weeks' interval the patient was up and about, doing office work. The pain gradually disappeared.

SYDNEY J. HAWLEY, M.D.

Rare Internal Injuries of the Knee Joint. E. Baumann. Schweiz. med. Wchnschr. **73:** 435–437, April 10, 1943.

Injuries to the meniscus can as a rule be diagnosed with a high probability of correctness. Operative treatment can then be employed with success; but there are many surgeons who think that the joint should not be opened until a positive diagnosis has been made. Among the conditions leading to confusion are chondromalacia of the patella, a fairly common condition which can be proved at operation and treated by removal of the macerated focus. Osteochondrolysis dissecans of the femoral condyles is also a source of error; this can usually be diagnosed roentgenologically, and is best treated by rest, which leads to better results than operative excision of the focus. The unstable and stiff knee can be treated by plastic operation with bands of fascia lata. If an injury to the meniscus is diagnosed, excision is indicated. Some discussion of surgical technic is included.

LEWIS G. JACOBS, M.D.

Two Rare Foot Injuries. J. Heer. Schweiz. med. Wchnschr. **73:** 449–451, April 10, 1943.

Two unusual cases are reported. The first is that of a 26-year-old man who was thrown off balance while carrying a 25-kg. weight on his shoulders. The strain was thrown on the front of the foot, which "cracked." Roentgenograms showed an upward and outward dislocation of the navicular on the talus with a fracture of the cuboid. Successful reduction was accomplished under ether anesthesia.

The second case was that of a 54-year-old factory worker whose foot was caught between an elevator and a wall. Roentgenograms showed fractures of the second metatarsal and the calcaneus (sustentaculum tali), but the most interesting part of the injury was a 90° rotatory dislocation of the cuboid. Reduction was accomplished by inserting a nail and turning the bone; a débridement and a plastic procedure were also necessary. Subcutaneous abscesses developed and considerable loss of function ensued.

LEWIS G. JACOBS, M.D.

Metastatic Lesions of the Sternum. H. B. Macey and G. S. Phalen. Surg., Gynec. & Obst. **76:** 453–455, April 1943.

This article reports the 2 cases of metastatic carcinoma of the sternum which are among the 14 cases of neoplastic involvement of the sternum in the Mayo Clinic files.

In each of these cases the chief complaint was a constant dull pain over the sternum, occasionally extending to the interscapular region. There was no palpable or demonstrable mass about the sternum, but the roentgenograms in each instance showed a destructive lesion involving the sternal body. The biopsy in the first case showed carcinoma; in the second case the original biopsy diagnosis was an inflammatory lesion, but postmortem examination revealed carcinoma.

The primary site was not definitely located in the first instance, but from the nature of the tissue and arrangement of cells in the biopsy specimen it was thought to be the lung. In the second case there was a large lesion in the right upper lobe of the lung which was reported on roentgenographic examination to be active tuberculosis but was found on pathological examination to be adenocarcinoma. The pathologist was not certain that this was the primary growth, though no other site was demonstrated.

The authors make the point that every patient with sternal pain should have a roentgenographic examination, and that a biopsy should be taken if a destructive lesion is found. The roentgen illustrations do not show the lesions well. JOHN O. LAFFERTY, M.D.

Metastatic Malignancy of the Spine. J. W. Toumey. J. Bone & Joint Surg. **25:** 292–305, April 1943.

This is a review of the 95 cases of malignant metastases in the spine seen between 1936 and 1940 at the Lahey Clinic. These occurred in a total of 2,067 cases of malignant growth seen in that period. Carcinoma of the breast was the primary lesion in 42 cases, carcinoma of the prostate in 11 cases, and Hodgkin's lymphoblastoma in 7 cases. The site of origin was unknown in 15 cases, and the remainder are variously accounted for.

Pain due to spinal metastasis is often confused with arthritic pain. Traditionally, severe constant back pain unrelieved by recumbency or salicylates is characteristic of cancer. At times the first evidence of the presence of a malignant neoplasm in the body is obtained from a roentgenogram of the spine showing a metastatic deposit.

The various types of spinal metastases are discussed but no new information is presented. The conception of irradiation therapy in these lesions is not too well presented. JOHN B. MCANENY, M.D.

Cystic Myxomatous Tumors About the Knee: Their Relation to Cysts of the Menisci. R. K. Ghormley and M. B. Dockerty. J. Bone & Joint Surg. **25:** 306–318, April 1943.

The authors present four cases of cystic myxomatous tumors about the knee joint, review additional cases from the records of the Mayo Clinic, and discuss the literature. A serious study both of the gross pathology and the microscopic pathology was undertaken in the cases recorded. Two were probably true cysts of the meniscus (one with an unusual amount of bone change); another was probably an unusually extensive development of a parameniscal cyst, while the fourth was a true myxomatous tumor. The authors conclude that cysts of the meniscus are probably not actual neoplasms, but represent the end-results of a degenerative process. Such cysts may sometimes be distinguished from other cysts in the region of the knee joint by the absence of an endothelial lining.

JOHN B. MCANENY, M.D.

Solitary Benign Enchondroma of Bone. H. L. Jaffe and L. Lichtenstein. Arch. Surg. **46:** 480–493, April 1943.

Solitary benign enchondroma is a cartilaginous tumor involving a single bone. The lesion appears most often in the phalanges, metacarpals, humerus, and femur, although other sites may occasionally be involved. It arises in the interior of the bone and may or may not cause distention of the cortex. Slow malignant transformation to chondrosarcoma is by no means rare.

The authors' series includes 28 cases, of which 12 were in males; the age range was from eleven to fifty years. Fourteen of the tumors were in phalanges, 5 in the metacarpals, 5 in the humerus, 3 in the femur, and 1 in a metatarsal. The clinical history is variable. There may be no symptoms until local trauma leads to pathological fracture, or the patient may give a history of a painless or slightly painful spontaneous swelling dating back several years. Repeated episodes of injury and recovery may be observed. A local bony swelling can usually be palpated.

In the phalanges the roentgenogram shows a centrally situated or eccentric oval area of rarefaction with or without bulging of the cortex. Small dense areas of ossification may be scattered through the rarefied area, which has a cloudy, vaguely trabeculated appearance. The lesion does not extend across an epiphyseal line. These phalangeal enchondromas are often misdiagnosed as cyst, giant-cell tumor, or osteochondroma; but a solitary tumor involving a phalanx is almost certainly an enchondroma.

Enchondromas of the metacarpals and metatarsals resemble roentgenologically those of the phalanges; they tend to appear in the distal part of the shaft. In these bones an area of fibrous dysplasia or an ossifying fibroma may closely mimic an enchondroma. In other long bones a similar situation obtains; the presence of small scattered areas of ossification in the radiolucent zone speaks strongly for enchondroma, but their absence leaves the situation uncertain.

Pathological studies of these tumors are rare, as they are seldom removed whole. In general, fragments of cortical bone from areas where there has been bulging of the cortex, as is commonly the case in the phalanges, metacarpals, and metatarsals, are thin and even shell-like. Fragments from lesions that do not cause bulging, as in the long tubular bones, show little thinning. In either case there are some erosive ridging and grooving of the medullary surface. The tumor tissue is a bluish-white, firm or somewhat myxomatous hyaline cartilage, containing some areas of calcification or ossification. There is a decided tendency to lobulation. In a true benign enchondroma the cells are small, with pale vacuolated cytoplasm and a small, single, rounded nucleus. Only occasional binucleated cells are present. If numbers of binucleated cells are present, if there is a general "plumping up" of the nuclei, and especially if there are numbers of large cells with large multiple

nuclei, the tumor is no longer benign and should be considered a chondrosarcoma.

The treatment of choice is conservative surgery: curettement, perhaps followed by chemical cauterization and implantation of bone chips or insertion of a solid graft. In one case 10 x-ray treatments (not given by the authors, and details unknown) failed to help the patient, and after operation infection developed in the bone. In 23 of the authors' 28 cases, results are known to have been good, without recurrence; fair results were obtained in 4 others, without recurrence, although various deficiencies were present, in some instances due to over-radical surgery. One patient had malignant degeneration of an enchondroma of the humerus; resection of the upper end of the bone was undertaken and there had been no recurrence after four and a half years.

LEWIS G. JACOBS, M.D.

Lesions of the Supraspinatus Tendon: Degeneration, Rupture, and Calcification. C. L. Wilson. Arch. Surg. **46:** 307–325, March 1943.

The subacromial bursa lies beneath the deltoid muscle, the coraco-acromial ligament, and the acromion, intervening between these structures and the supraspinatus tendon. Its floor is formed by the blended fibers of the four short rotators (the supraspinatus, infraspinatus, teres minor, and subscapularis), the so-called "musculotendinous cuff." The attachment of the tendons is on the upper half of the sulcus, which constitutes the anatomical neck of the humerus, and on the greater tuberosity. The function of the rotator muscles, which tend to act as a unit, is to hold the head of the humerus in the glenoid in abduction. The long head of the biceps also acts as a stabilizer.

Rupture of the supraspinatus tendon was first recognized by J. S. Smith in 1835 (Am. J. M. Sc. **16:** 219, 1835). It occurs as a transverse tear within half an inch of the insertion on the greater tubercle. Incomplete rupture may take place on the joint side (a "rim rent"), in the floor of the subacromial bursa, or within the substance of the tendon. Generally communication is established between the subacromial bursa and the joint space. In some cases all four tendons may be avulsed. After rupture of long standing the tab of tendon on the humerus disappears and small bony excrescences form; the walls of the bursa, normally film-like, become thick as blotting paper, and synovial villi are found in the bursa. The tendon of the long head of the biceps, exposed by the tear in the supraspinatus tendon, may fray or rupture.

Rupture of the supraspinatus tendon was found in 20 per cent of an autopsy series and in 26.5 per cent of a series of anatomic cadavers. Its cause is not certainly known, but it is thought to be due to degenerative changes in the tendon in late middle and advanced age. Laborers are more prone to this accident than sedentary workers.

The clinical picture starts with an acute trauma, usually a fall with sudden elevation of the arm. Immediately sharp, brief pain is felt at the tendon insertion, but the pain is seldom severe enough to cause the patient to stop work. Later in the day the pain becomes worse and even intolerable. There is inability to raise the arm, but little limitation of motion when the patient leans forward at the hips with the arms hanging. A tender point and sometimes a ridge can be felt anterior to the acromion tip with the arm in dorsal flexion; these disappear as the arm is passively elevated. If the findings are doubtful and the patient can hold the arm in right-angle abduction, complete rupture is not present. The initial pain is severe, but it later becomes nagging and continues unchanged for months; it is aggravated by work. After two to five years the pain may disappear spontaneously. The initial symptoms of rupture of the long head of the biceps are variable.

Two roentgenographic methods have been employed in diagnosing rupture of the supraspinatus tendon. Henry (Am. J. Roentgenol. **33:** 486, 1935) uses a soft-tissue technic with the arm adducted and internally rotated; immediately after injury fine spicules of bone can be shown on or near the greater tuberosity; but if rupture occurs in the critical part of the tendon the findings may be normal. Lindblom (Acta radiol. **20:** 548, 1939) injects 6 c.c. of 35 per cent diodrast mixed with 1 c.c. of 1 per cent procaine hydrochloride into the shoulder joint. In the intact joint the roentgenogram shows only the joint space, but if rupture has occurred the subacromial bursa is also filled. In early cases treatment by surgical repair is successful.

Calcification of the supraspinatus tendon was first recognized in roentgenograms by Painter in 1905 (Boston M. & S. J. **156:** 345, 1907). Pathologically there is a boil-like elevation on the floor of the subacromial bursa, containing a soft creamy calcium deposit. This may rupture into the bursa, producing a chemical bursitis. In the chronic phase there is little to be seen in the bursa, and the deposit becomes cheesy or gritty. The calcium is deposited either as the phosphate or oxalate. Such calcifications were found (with a fluoroscopic technic) in 2.7 per cent of 6,061 supposedly normal persons by Bosworth (J. A. M. A. **116:** 2477, 1941). Long continued use of the arm in abduction seems to be a predisposing factor. A single trauma does not cause calcification, but may precipitate symptoms. Infection plays no part in the condition.

Symptoms may be absent, or chronic or acute pain may be present. Acute attacks are excruciating and the pain is aggravated by any movement of the arm. Voluntary fixation may even lead to contracture. Spot roentgenography after fluoroscopic localization will demonstrate the calcification. In the acute stage, prompt excision is advocated. In the chronic stage treatment is difficult to evaluate because recovery takes place regardless of the measures employed. Operation is nevertheless advocated for these patients also.

Subacromial bursitis is always a secondary condition. Calcification and rupture of the supraspinatus tendon may lead to a bursitis; tuberculosis of the bursa is rare. The so-called "frozen shoulder" may be treated by forced abduction, although the bursa shows little change on examination.

A comprehensive bibliography accompanies this paper.

LEWIS G. JACOBS, M.D.

THE SPINAL CANAL

Two-Needle Oxygen Myelography: A New Technique for Visualization of the Spinal Subarachnoid Space. D. Munro and C. W. Elkins. Surg., Gynec. & Obst. **75:** 729–736, December 1942.

The authors discuss the advantages and disadvantages of lipiodol, thorium dioxide, air, and oxygen as media for the visualization of the spinal arachnoid space. Both air

and oxygen are satisfactory contrast media, provided the canal is filled, and have the advantage that they are readily absorbable and do not serve as permanent irritants. In many cases, however, x-ray films made according to the Chamberlain and Young technic, with the alternate injection of air and withdrawal of spinal fluid, are worthless from a diagnostic standpoint because of poor or inadequate filling. This is believed to be unavoidable because of the fallacious hydrodynamics inherent in the technic.

The authors came to the conclusion that the use of oxygen had the fewest disadvantages and therefore modified Chamberlain and Young's method in such a way as to make it hydrodynamically correct and, instead of one, used two spinal needles. By placing one needle in the low lumbar region and varying the position of the other, they are able to fill the spinal canal accurately and satisfactorily not only in the lumbar region, but in the thoracic and cervical regions as well.

The technic of two-needle myelography is as follows: After preparation, consisting of one ounce of castor oil by mouth and a soapsuds enema on the night previous to the examination, the patient is placed in the lateral position on a tilt-top x-ray table with a Bucky-Potter diaphragm. An adjustable webbing sling keeps the patient in place when the table is tilted. A low lumbar puncture is performed, followed by another puncture at the desired cephalad level of fill. If the entire canal is to be visualized, the cephalad needle is placed in the cisterna magna. If the thoracic and lumbar region is to be visualized, the cephalad needle is placed at the desired level in the thoracic region. If done with care and proper technic, the thoracic spinal puncture may be performed with impunity. If the lumbar area alone is to be visualized, the cephalad needle is placed between the twelfth thoracic and the first lumbar vertebra. Number 18 gauge Fremont-Smith needles with three-way stopcocks are used for the punctures. Simultaneous pressure readings, water manometers being used, are taken from the needles. The Queckenstedt block test is done by means of a blood pressure cuff around the patient's neck to compress the jugular veins. The cuff pressure is increased by increments of 10 mm. of mercury until a pressure of 40 mm. is recorded in the cuff. The spinal fluid pressure is determined and recorded after each increment. The cuff pressure is then lowered by increments of 10 mm. of mercury until the pressure is zero in the cuff. The spinal fluid pressure after each increment is determined and recorded. By this method, differential intraspinal pressures are obtained and, if a block exists between the two needles, it may be demonstrated. Partial block may also be demonstrated by this method.

Two cubic centimeters of spinal fluid are now removed from each needle. This is for protein determinations and cell counts. Differential protein values are thus obtained simultaneously from below and above the suspected lesion.

After the fluids are collected, the patient's head is lowered to 25 degrees below horizontal and both needles are opened. Fluid will flow from the cephalad needle and, as this occurs, oxygen is slowly injected into the caudal needle. The injection is made from a sterile 50-c.c. syringe which has been filled from a small oxygen tank. Care must be taken not to inject the oxygen under pressure, as this expands the canal and may possibly distort it. When spinal fluid ceases to flow from the cephalad needle and oxygen appears, both needles are closed. Stereoscopic lateral roentgenograms are then taken of the lumbar and thoracic levels. Oblique views are used and satisfactorily replace both the lateral and anteroposterior views in the cervical level. This is done so that the tracheal shadow will not be superimposed upon the injected column of air. As little delay as possible should occur between the completion of injection and exposure of the x-ray films, since the gas tends to absorb quite rapidly in some cases. To avoid this complication, the needles are left in place while the lateral views are taken. After these are completed, both needles are again opened and more oxygen is injected. The needles are then withdrawn, the patient is quickly turned on his back, and stereoscopic anteroposterior and oblique films are taken. Twenty to thirty cubic centimeters of oxygen are usually sufficient to fill the lumbar area, 40 to 50 the midthoracic and lumbar areas, and 75 to 100 the entire spinal canal.

Sixty-nine myelograms have been done by the two-needle method on 60 patients. With the assistance of the myelograms, the decision was reached that 37 of the 60 patients studied did not need surgical interference. In 31 patients in this group, the findings were considered normal. In 9 patients a diagnosis of protrusion of the nucleus pulposus following rupture of an intervertebral disk was made on the evidence of the myelogram and other data. At operation the protruded nucleus was found exactly as demonstrated by the myelogram in every instance. Seven patients were explored for a suspected ruptured intervertebral disk in spite of negative two-needle myelograms, but none was found. The operative findings disagreed with the myelogram in only 2 of the 23 patients that were operated upon.

Myelograms were repeated in 5 instances because the first ones were not satisfactory. Satisfactory visualization of the subarachnoid space was eventually obtained in every case.

Roentgenologic Diagnosis of Dilatations of the Spinal Cord Veins: Report of a Case. B. S. Epstein and L. M. Davidoff. Am. J. Roentgenol. **49:** 476–479, April 1943.

Intraspinal vascular dilatations may occur as true dilatations of the pial veins, as arterial or arteriovenous aneurysms, or as hemangiomas. The last form a separate group and are neoplastic. Non-neoplastic venous dilatations may be due to some interference in the spinal venous circulation or to congenital anomalies in the development of the veins. Diagnosis may be possible on roentgen examination with iodized oil as a contrast medium. A case is reported in which a correct preoperative diagnosis was possible by this method. The varices produce a pattern of negative serpentine shadows, since the dilated veins lie in the spinal canal and are surrounded by the cerebrospinal fluid. Roentgenoscopic inspection revealed a free flow of the oil throughout the canal, but the film showed the presence of numerous negative shadows with smooth, parallel sides in the lower cervical region and a similar defect in the lower dorsal area. Laminectomy revealed a thick vermiform varix on the dorsal aspect of the cord, extending beyond the limits of the operative field. A constant roentgenographic picture need not be present, since the veins may on occasion be dilated and at other times collapsed.

Roentgenograms are reproduced, illustrating the case reported. L. W. PAUL, M.D.

THE GENITO-URINARY TRACT

Technical Considerations in Excretory Urography. R. O. Pearman. New England J. Med. **228:** 507–508, April 22, 1943.

In an attempt to determine the best preparation for excretory urography 200 cases were studied and the following observations were made. Good technical films are essential. If the blood urea is above 70 mg. per 100 c.c. it is unlikely that good excretion will occur. Abdominal compression is not of value, but a 5- to 10-degree Trendelenburg position may afford better filling of the pelves.

Films are taken at five, twenty, and forty-five minutes after injection. In patients with hypertension the first film should be exposed at three minutes because of the rapidity of excretion in these cases. If satisfactory visualization is obtained at five minutes, renal function may be considered to be good, but the reverse of this is not always true.

The best preparation of the bowels seems to be limitation of fluid intake to 250 c.c. for 8 hours, omission of meals, and castor oil with or without an enema about fourteen hours before roentgenography.

JOHN B. MCANENY, M.D.

Pyelograms in Patients with Essential and Malignant Hypertension. J. C. Shrader, J. M. Young, and I. H. Page. Am. J. M. Sc. **205:** 505–514, April 1943.

This study was undertaken to determine whether or not there is a pyelogram characteristic of hypertension and to compare the incidence of abnormal pyelograms in an unselected group of patients with hypertension with that in an unselected group of "normotensive" controls.

Retrograde pyelograms were studied with regard to morphology, such as level in relation to the vertebrae, renal rotation, capacity of the pelvis, calyceal size in relation to pelvic size, and tendency to bifid pelvis.

Twenty-two per cent of a group of easily recognizable renal abnormalities occurred in patients with hypertension, a figure in general agreement with those of other investigators. Nineteen per cent of a series of hypertensive patients showed abnormal pyelograms. The average mean arterial pressure, however, was the same in subjects with normal and abnormal pyelograms.

The authors conclude that the retrograde pyelograms of patients with essential hypertension do not differ significantly from those of "normotensive" subjects, and that the incidence of urographic abnormalities in an unselected group of "hypertensives" appeared to be no greater than in "normotensives." It was their impression that the range of normal variation in urograms is wider than is usually recognized. Questionable pyelographic variations in patients without hypertension are often disregarded, while the same variations in the hypertensive patient are emphasized, and he becomes a so-called "renal hypertensive."

BENJAMIN COPLEMAN, M.D.

Aneurysm of the Renal Artery. O. S. Lowsley and E. M. Cannon. J. A. M. A. **121:** 1137–1143, April 3, 1943.

In this article is described the seventy-fifth case of aneurysm of the renal artery that has been reported and the twelfth that has been diagnosed preoperatively. True aneurysm in this location is probably due to a congenital defect in the arterial wall, and, when small, generally presents no clinical symptoms. When it enlarges, the most constant symptom is flank pain. Rupture of the aneurysm produces a false aneurysm or retroperitoneal hematoma, which may be palpated as a mass in the flank or upper abdomen. A systolic bruit or pulsation is pathognomonic but only rarely encountered. Hematuria is uncommon.

The significant roentgenographic sign is a ring-like shadow of calcification with a dense periphery disrupted in one portion, located in the kidney or hilar region. This sign, of course, is not always present and must be differentiated from a host of other shadows which may occur in this same area.

The prognosis in symptom-producing aneurysms of the renal artery is grave unless nephrectomy is performed. An exploratory operation is justified when the abnormality is suspected, even though signs and symptoms are lacking.

Various discussants of this paper emphasized the potentialities of arteriography and less radical vascular surgery, in the diagnosis and treatment of this rare condition.

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VENOGRAPHY

Method for Obtaining Venograms of the Veins of the Extremities. H. Mahorner. Surg., Gynec. & Obst. **76:** 41–42, January 1943.

The author's technic for visualization of the veins of the extremities is as follows. With the patient sitting on the x-ray table with legs dependent, a 20-gauge needle is inserted into a vein on the dorsum of the foot or on the ankle, one of the tributaries of the internal saphenous system. (The course of the internal saphenous is anterior to the internal malleolus and relatively superficial, usually permitting insertion of needle without an incision.) The tubing of an infusion set containing normal salt solution is connected with the needle and the infusion is permitted to drip relatively rapidly. The needle is then strapped securely in position with adhesive and the patient lies down on the table. A large cassette containing the films is placed behind the calf and thigh and the leg is slightly rotated externally. A tourniquet is applied around the leg, usually at the junction of the middle and lower thirds, sufficiently tight to impede circulation in the superficial veins, which shunts the infusion from the superficial into the deep system. Twenty cubic centimeters of diodrast (35 per cent) are then slowly injected into the tubing of the infusion set just above the needle. Five seconds after the diodrast is completely delivered, an exposure is made. After the exposure the infusion continues to run for 200 c.c. to wash the diodrast from the veins. It is then possible to rotate the leg and get a lateral or oblique view or, if desired, a new plate may be placed higher under the thigh and the femoral veins exposed. Venograms made with this technic are reproduced A word of caution as to possible complications is added.

FOREIGN BODIES

Simple Foreign Body Removal. S. D. Mesirow and R. A. Arens. Illinois M. J. **83:** 179–182, March 1943.

A simple method of removing a foreign body by combined fluoroscopy and surgical exploration, based

on the principles of the "nearest point method" given in the U. S. Army X-Ray Manual, 2nd edition, is presented. This method involves the use of a small hand screen which can be placed in the field of operation without producing contamination, as described by Arens (Am. J. Roentgenol. **14:** 460, 1925).

The authors bring out the point that, since there may be and usually is movement of the foreign body or of the tissues containing it, either before or during exploration, intermittent fluoroscopy offers a constant control by indicating continuously the position of the foreign body. This method of removal is not suitable for foreign bodies deep in the lung fields, within the abdominal cavity, or those requiring exploration of vital structures.

With regard to the possibility of radiation injury, the authors state that in the usual case there is an average of five to ten minutes' actual working time from incision or probing into the wound of entry until removal of the foreign body, involving at most one to two minutes of actual fluoroscopic time. "Using 85 PEv., 4 ma., 1 mm. Al, one obtains radiation equivalent approximating 5 r per minute, a relatively insignificant amount. A small cone of radiation is used sufficient *only* to fill the screen of the roentgenoscope." Continual use of one roentgenologist-surgeon team might, however, constitute a hazard due to the possible effects of cumulative radiation.

READING OF ROENTGENOGRAMS

The Reading of Roentgenograms (In commemoration of Dr. R. Lindt, of Aarau, 1868–1940). W. Jaeger. Schweiz. med. Wchnschr. **72:** 1429–1431, Dec. 26, 1942.

Although the roentgenogram is in itself unchangeable, there is no absolutely pathognomonic picture of a disease. Changes in the shadows may be of such magnitude as to imply certain pathological processes, but the picture may be influenced by technic and positioning as well as by the physical peculiarities of the patient. Stereoscopy may be helpful, but is of limited scope, since about half of all persons have no faculty for stereoscopic vision and some of the others misinterpret the location of what they see. We must not forget, therefore, that we are merely interpreting shadows. (The best proof of the difficulty of this is to try to identify, out of a series of shadow profiles, that of one's own wife!) For this reason it behooves us to correlate our pictorial findings with the history and clinical findings in reaching a diagnosis.

Physical qualities such as thickness and density and superimposition of shadows may alter a picture materially. This means that the positioning of the patient must be precise and the technical factors accurate. Individual anatomical variations, especially in the skeleton, must not be misinterpreted; they are numerous and a frequent source of error. Studies of the soft tissues with contrast media must be interpreted with caution, three questions being borne in mind: (1) Is the filling complete? (2) Is the contrast medium spilled on the body surface, or are the ramifications observed internal? (3) Does the body react to this medium in any abnormal fashion?

Finally, one must study the entire roentgenogram for changes, remembering that parts other than those principally under consideration may be the seat of disease or abnormality. LEWIS G. JACOBS, M.D.

Diagnostic Judgment in Traumatic Medicine and the Roentgenogram. F. Lang. Schweiz. med. Wchnschr. **73:** 497–500, April 24, 1943.

Roentgenograms are objective documents which preserve conclusive evidence of pathological states for the future. This diagnostic aid is frequently indicated in traumatic medicine. Its use depends on two factors, namely, the technical skill with which the picture is made and the knowledge and skill of the interpreter. Roentgenograms must be made as often as indicated, since it is false economy to miss minimal lesions which, when untreated, may lead to high grades of invalidism or disability. For the same reason, an adequate number of films must be made.

Roentgenograms should be made more often in cases in which a bone lesion is suspected; after accidents which frequently lead to fracture, even in the absence of clinical evidence of fracture; of adjacent parts after injuries with positive findings in one area; in the presence of persistent, obscure pain; always if compensation is an issue. Films should be made in two planes and should be large enough to cover the entire area involved; interval studies are usually advisable.

A number of illustrative cases are briefly cited. Particularly striking are illustrations of a fracture of both bones of the forearm, missed on the original study because too small an area was included in the film, and of a spondylolisthesis undiagnosed because the top only of the fifth lumbar vertebra was included in the original study.

Although this article contains nothing not already well known, the general practitioner and industrial surgeon will find it profitable reading.

LEWIS G. JACOBS, M.D.

Medical Facts That Can or Cannot Be Proved by Roentgen-Ray: Historical Review and Present Possibilities. S. W. Donaldson. Ann. Int. Med. **18:** 535–550, April 1943.

The author cites various instances in which the courts have recognized the necessity not only of accurate portrayal of parts on the roentgenogram but also of expert interpretation of the findings.

The fundamental concept for roentgen ray examination is that a roentgenogram "is merely a photographic record of the different densities through which the x-ray has passed." The obvious conclusion is that a diagnosis cannot be made if a difference in density cannot be demonstrated.

The author lists, by systems, the diseases in which roentgenography can and cannot be considered diagnostic. Recognizable radiologic conditions, such as fractures, calculi, bone lesions, etc., will be omitted from further discussion here. A brief review of nonrecognizable conditions follows:

Eye: Non-opaque foreign bodies in the eye, as well as soft tissue lesions of the eyeball and orbit, are not demonstrable in the absence of secondary bone changes.

Chest: The effects of noxious gases upon the mucous membranes of the tracheobronchial tree are negative roentgenologically. Similarly, spray painters using cellulose products fail to show any lung changes in the roentgenogram.

Abdomen: Acute appendicitis, acute pancreatitis, and pelvic inflammatory disease rarely show diagnostic differences in density on routine examination. This is also true of diseases of the spleen which do not produce enlargement or cause calcification. In rupture or per-

foration of the liver or spleen, the x-ray findings may be apparent, but not sufficiently convincing for a positive diagnosis.

Circulatory System: Peripheral vascular diseases, varicose veins, and thrombophlebitis usually present no positive roentgen-ray findings, except on special examination with contrast media. Neurotrophic conditions resulting in atrophy of the bones of the hands and feet, as Raynaud's or Buerger's disease, show changes of the bone, but never of the vessels, even with the soft-tissue technic.

Bones and Joints: A positive decision that herniation of an intervertebral disk extends into the spinal canal cannot be made without the aid of a contrast medium, either air or iodized oil. Acute conditions, as acute osteomyelitis and joint tuberculosis are not readily recognizable. Small areas of metastatic cancer are not always visible even though they may be suspected clinically. Myositis ossificans (calcium deposit in the muscle) is a frequent post-traumatic finding in cases in which the films at the time of injury were negative. In the great majority of acute sacro-iliac cases, the x-ray findings are negative. In hypertrophic osteo-arthritis, lipping, spurs, or marginal deposits are brought about by chronologic or anatomic age, and are physiological in nature. Obviously, aggravation of these changes is impossible, as they represent normal healthy bone.

Genito-Urinary System: Such unusual conditions as carbuncle of the kidney and hemorrhagic nephritis, and their complications, cannot be readily diagnosed Dysmenorrhea and acute venereal infections are not within the province of the radiologist.

Cerebro-Nervous System: Most of the diffuse organic neurological conditions, such as multiple sclerosis, amyotrophic lateral sclerosis, and nerve injuries, especially those of the brachial plexus at birth, are not amenable to x-ray diagnosis. Meningitis and encephalitis offer little information roentgenographically.

The author concludes with suggestions for further research. It is possible that the pancreas might be visualized by developing a chemical substance which would be electively secreted with the pancreatic juice. The electron microscope may eventually perfect the fluoroscopic screen so that objects of fine structure will be seen with ease. The radioactive substances produced by by the cyclotron present further possibilities.

STEPHEN N. TAGER, M.D.

RADIOTHERAPY

NEOPLASMS

Cancer of the Nasopharynx. C. L. Martin. Ann. Otol., Rhin. & Laryng. **52:** 146–160, March 1943.

Because surgery has accomplished relatively little in the treatment of cancer of the nasopharynx, many otolaryngologists have adopted a gloomy attitude toward the treatment of this condition. Since the divided dose method of administering x-ray therapy advocated by Coutard came into use about ten years ago, the picture has changed, however, and an encouraging number of cures have been reported. In 1940, Martin and Blady (Arch. Otolaryngol. **32:** 692, 1940) reported 25 per cent of five-year cures in a series of 80 patients, and in 1942 Lenz (Am. J. Roentgenol. **48:** 816, 1942) 27.6 per cent of 44 patients. All of these cases were treated by irradiation alone and each series includes all of the patients treated regardless of the stage of the disease.

Those promising results are based on the fact that approximately 85 per cent of the primary lesions are so radiosensitive that they can be completely eradicated by doses of irradiation which produce no irreparable damage to normal tissues. While such therapy sets up painful reactions in the mucous membranes and the skin of the treated areas, these reactions heal in two or three weeks and are relatively insignificant when compared with the results obtained.

From a review of his own cases conducted in 1939, the author observed that many of the failures resulted from the appearance of metastases in the mediastinum or intracranial cavity four to six months after the disappearance of all evidence of the disease in the pharynx and the cervical region and came to the conclusion that more cures might be obtained by administering additional irradiation to the base of the skull and thorax in the early cases. He describes the technic as follows:

"1. Areas laid out over each side of the pharynx should extend from the lateral wall of the orbit to a point one-half inch behind the mastoid and should include the base of the skull and the submental area as well as the upper portions of the triangles of the neck. The total dosage given to each area during a period of three and a half weeks averages 3,200 roentgens measured in air and should rarely exceed this amount.

"2. When the reaction from this series has subsided, a third area of similar size laid out over the base of the occipital region and the back of the neck should receive 3,000 roentgens at the rate of 300 roentgens per day.

"3. At, or about, the same time 2,400 roentgens should be delivered through 15-cm. portals to the front and back of the upper mediastinum at the rate of 300 roentgens per day in an effort to forestall downward extension through the lymphatics in this region."

The author states that, although no five-year statistics are yet available, the results observed in a small group of patients have been encouraging.

Intra-oral Radium Treatment of Cancer of the Mouth. Part I. Choice of Method. Part II. Technique. J. R. Nuttall. Brit. J. Radiol. **16:** 45–48, February, 1943; 72–81, March 1943.

This article represents in summary the experience in treatment of 1,300 patients between 1932 and 1938 in the Manchester Radium Institute.

As squamous-cell carcinoma is relatively resistant, there is only a small margin between the dose lethal to the tumor and the dose which will produce necrosis in normal tissue. The optimum dose is between 6,000 and 8,000 r delivered in seven to ten days. The first onslaught should be the largest possible, for normal tissues will probably not stand a second.

At the outset a decision should be made as to the object of treatment. If there is no reasonable chance

of cure, the treatment should be less vigorous, and the aim should be only palliation. As a rule, extensive lesions and lesions in the very old should be treated palliatively. Inoperable lymph nodes prevent the possibility of cure; operable ones, however, do not. The general condition of the patient is often the deciding factor. The presence of constitutional complications, such as diabetes mellitus, makes anything but palliative treatment inadvisable.

Two types of treatment are available, molds or implantation. The type chosen depends upon the size and location of the lesion. In general, molds are better, where they can be used. Occasionally a combination of the two is most advantageous.

The diagnosis is usually obvious. In doubtful cases a biopsy should be done. Biopsies do not increase the incidence of metastasis. The Wassermann reaction is not a differential diagnostic aid, as often both syphilis and cancer may be present. Since the response of cancer in the presence of syphilis is not good, however, it is important if the latter is present to recognize it and treat it.

Occasionally a biopsy will reveal only inflammatory tissue in the presence of a highly radiosensitive reticuloendothelial type of tumor. Tuberculosis of the mouth frequently resembles carcinoma. A differential diagnosis may then be made only by a pathologist. Granulations around a septic root may also resemble cancer. Biopsy is very important here, as cancer may also be present. There is a frequent association of oral cancer and microcytic anemia in women. The anemia should be treated before irradiation is started.

It is important to know, in carcinoma of the palate, whether or not the antrum is invaded.

If the teeth are good, and do not irritate the diseased area, they should be left intact. Carious and tender teeth in or near the treatment area should be removed before treatment is started. Teeth should not be removed from an area which has received treatment, because of the danger of necrosis of the jaw.

Of 442 patients suffering from cancer of the mouth in all stages, treated in 1932 and 1933, 28 per cent survived for five years. Of the group with small lesions with no metastatic nodes, 62 per cent lived five years. Of those with extensive lesions with no nodes, 33 per cent; with operable nodes 18 per cent; and with inoperable nodes only 3 per cent survived five years.

In planning treatment with molds, it should be remembered that the molds must be removed for dental hygiene, meals, and during sleep. Opinions differ about the necessity of shielding parts not included in the treatment area. In certain situations it is not possible to shield all areas.

The choice of mold depends upon the size and site of the lesion. Single plane molds are used for small lesions of little depth. Sandwich molds are useful in the floor of the mouth, cheek, and lower lip.

As the molds are not worn continuously, some check is necessary on their correct reinsertion. They should be cleaned on removal, and stored where they are secure against loss or injury, and where they are well enough screened so there is no injury to attendants.

The implantation of radium is greatly aided by a good anesthetic. Intratracheal anesthesia is the most suitable type. During the immediate postoperative period special care is required to prevent pulmonary complications. Sedatives should be used. During the first three to four hours, inhalations of carbon dioxide and oxygen should be given for ten minutes out of each hour.

The actual implantation demands skill which is only acquired with practice. Care should be exercised to see that the implants are properly placed the first time, as a second anesthetic and second placement are dangerous. The needles should be fastened so they do not come out. X-ray examination is used to see that they are correctly placed. Threading the silk attached to the needle through soft rubber tubing is of aid in preventing its fouling.

The simplest type of implantation is the single plane implantation. In this a block of tissue the size of the plane to be treated and 1 cm. thick is given the desired dose. Unless the plane is very large, it is wise to give a larger dose for single plane implantations than for other types. It is usually safe to give 7,000 r in seven to ten days for a medium-sized plane.

Multiple plane implantations or volume implants are necessary for larger and thicker lesions. Maximum and minimum doses should be in the range of 5,000 to 6,500 r in seven to ten days. Volume implantations should be used with great care because of the danger of radionecrosis.

The removal of the needles does not usually require an anesthetic. Care should be used not to break the silk attached to the needles, as they are very difficult to find if the silk is detached. Particular gentleness is required in removing the needles from the soft palate, as it tears and bleeds easily. Premature removal of the needles is sometimes required. Before this is done, it should be remembered that reinsertion will probably never be possible.

Nursing care of the patient is important. Mouth hygiene should be kept up. The patient should understand what is going to be done before treatment is started so he can co-operate. Maintenance of adequate nourishment is important and often difficult. The patient should receive 1,800 calories daily. Special high-caloric liquids may be required. During the reaction period the nourishment problem may be more difficult, but is still of great importance.

The usual reaction is a raised yellow fibrinous one, starting about the second week and lasting about six weeks. After the reaction has subsided, fibrosis frequently occurs. It is sometimes difficult to distinguish this fibrosis from recurrence. Biopsy or further treatment is dangerous.

Block dissection of the neck should not be undertaken during the reaction period. Interference with the circulation is apt to produce necrosis. Preliminary dissection of the neck and irradiation of the oral lesion as soon as the neck is healed are not advised, as the interference with circulation may seriously hamper successful radium treatment.

SYDNEY J. HAWLEY, M.D.

Cancer of the Uterus: Results of Present Method of Radium Therapy as Influenced by Stage and Grade of Lesion. H. H. Bowing and R. E. Fricke. Am. J. Roentgenol. **49**: 487–493, April 1943.

Cancer of the cervix is accessible to inspection and palpation, permitting definite delineation of the stage or extent, while the microscopic grade can be determined by biopsy. As a result, an individualized plan of radium and roentgen therapy can be utilized. In a series of 1,491 cases the authors' results showed 60.2 per cent five-year cures in Stage 1 lesions, 60.2 per cent

for Stage 2, 29.7 per cent for Stage 3, and 6.5 per cent for Stage 4. The microscopic grade of the cancer has been of importance from a surgical prognostic standpoint in that patients with high-grade lesions do poorly after surgical intervention. With individualized radium therapy, lesions of grades 3 and 4 are no more fatal than lesions of grades 1 and 2.

Cancer of the uterine fundus presents a greater radiotherapeutic problem. Being a hidden lesion, it is not accessible to inspection and less revealing on palpation. Because of this, the technic of irradiation cannot be individualized to the same extent as for cervical lesions. The five-year survival rate is influenced by the stage of the lesion, varying from 93 per cent five-year cures for Stage 1 to 6 per cent for Stage 4 lesions. The data concerning patients treated from 1910 to 1938, inclusive, at the Mayo Clinic showed that, in respect to five-year survival rate, total abdominal hysterectomy with and without irradiation yielded almost similar results, 67.5 per cent and 66.6 per cent, respectively. Cancer of the uterine fundus, however, mainly afflicts women in the later age group, and other unrelated degenerative diseases often complicate the picture and increase the operative risk. Practically a third of all patients seen at the Mayo Clinic with carcinoma of the fundus were referred for irradiation alone because of the extent of the lesion and the presence of associated disease.

From their experiences, the authors believe that the extent of the primary malignant lesion of the uterus is the most valuable prognostic factor. The grade of malignant change is of prognostic significance when more standardized surgical and radium therapeutic technics are employed, though this is not so true when individualized radium therapy is employed in cancer of the uterine cervix. L. W. PAUL, M.D.

Cancer of the Cervix: Effect on the Rate of Cure of Increased Roentgen Radiation to the Parametria. W. P. Healy and G. H. Twombly. Am. J. Roentgenol. **49:** 519–530, April 1943.

An analysis is given of 920 cases of primary cancer of the cervix treated at the Memorial Hospital in the six years 1932–1937. During this period the method of giving radium was practically constant, while several different schemes of external roentgen therapy were used. It was felt, therefore, that this group of cases offered an ideal set of statistics for an inquiry into the question of what value roentgen therapy may have in the treatment of cancer of the cervix and what form of roentgen therapy appears to be the most effective. The results are given in tabular form and show that when the so-called "massive dose" technic was used, a 28.5 per cent five-year cure rate followed. With the "divided dose" technic the five-year cure rate rises to 35.4 per cent. As far as could be determined, this difference was not due to the extent of the disease, the age of the patient, or the grade of tumor found to be present.

The "divided dose" technic embodies the use of six pelvic fields with a target skin distance of 70 cm. and daily doses to each of two fields of 200 r. The total dose per field was 2,000 to 2,400 r. The physical factors were 200 kv., 30 ma., and 0.5 mm. Cu plus 2.0 mm. Al filtration. An estimated three to five threshold erythema doses were delivered to the parametria for a distance of 10 to 11 cm. lateral to the cervical canal by this method. The "massive dose" technic consisted in the administration of doses of 700 to 750 r to each of four or six pelvic portals.

Other observations noted during the course of this study were that the peak in age incidence lay between forty and fifty-five years. Only 24 of the 920 patients were unmarried, and of these, 6 admitted that they had borne children. Among the foreign-born, Italians showed the highest incidence. Only 5 per cent of the patients were Jews, in spite of the large Jewish population of New York City. L. W. PAUL, M.D.

Effect of Preoperative Irradiation on Adenocarcinoma of the Uterus. H. E. Schmitz, J. F. Sheehan, and Janet Towne. Am. J. Obst. & Gynec. **45:** 377–387, March 1943.

Seventy-seven patients with adenocarcinoma of the uterine fundus were treated with the aid of a Y-shaped radium filter. Of this total, 38 had preoperative and 39 postoperative irradiation. Only the former are included in this study. In 11 cases hysterectomy was subsequently performed and the effect of irradiation on the tumor and uterus was studied. Five of these patients were adequately treated, and in none of these was residual carcinoma found on serial block studies. The remaining 6 cases, all inadequately irradiated, showed carcinoma. Twenty-seven patients were irradiated, without subsequent hysterectomy. Ten of these had one or more curettages to determine the presence of active disease, and these also furnished evidence as to the value of irradiation in cases of clinical groups I and II.

All patients are curetted. The Y-capsule, containing 50 mg. of radium element in each arm, is immediately inserted into the uterine cavity. The width of the uterine fundus has been determined and the capsule opened as described in an earlier paper (Am. J. Roentgenol. **34:** 749, 1935). After a dose of 2,000 mg.-hr., the capsule is removed. On the 8th and 16th days, the dose is repeated. This gives a total radium dose of 6,000 mg.-hr. On days, when the radium is not in the uterus, the patient receives x-ray therapy; 4,000 r are applied in 10 fractions at 48-hour intervals with an 800-kv. machine, 10 ma., F.S.D. 70 cm., half-value layer 8.2 mm. Cu, 36 r per minute. Two fields, pubic and sacral, are used. If the anteroposterior diameter is 23 cm. or more, three or four fields are used. The dose attained within the pelvis after twenty-eight days was 4,000 r with back-scatter.

The authors suggest that a plan of preoperative irradiation should be followed until enough case records are available to determine whether the five-year salvage is greater in cases of preoperative or postoperative irradiation.

In the discussion which followed, Dr. Schmitz stated that 7.5 to 8 erythema doses in the uterus were given. The Y-applicator was adopted to control the position of the radium in the uterus. The shifting of capsules, if placed in series in a rubber tube, cannot be prevented. Delaying the operation was no factor in the recurrence of carcinoma, if it were thoroughly irradiated. Irradiation causes no disturbance of the capillary bed. Hence, no difficulty in surgery or immediate surgical mortality should be expected.

STEPHEN N. TAGER, M.D.

Elimination of Irradiation Injuries in the Treatment of Cancer of the Cervix. C. L. Martin. Am. J. Roentgenol. **49:** 494–503, April 1943.

During the past ten years an attempt has been made

in the author's clinic to eliminate the serious complications associated with radiation treatment of cancer of the cervix without lowering the total five-year survival rate. The author lists some of the technical changes, as follows: "1. Use of multiple radium sources of moderate intensity for longer periods of time. 2. Frequent shifting of the positions of radium containers of the higher intensities. 3. Heavy filtration in all radium containers. 4. Distance applicators in the vagina used with large vaginal packs. 5. Removal of all presenting tumor tissues so that a smaller total radium dosage is effective. 6. Careful approximation of radium sources to malignant tissue. 7. Copious use of green soap in vaginal preparation for radium. 8. Frequent changing of vaginal packs. 9. No radon implants used and no radium needles placed near ureters. 10. Intensive roentgen therapy used only in more advanced cases. 11. Elimination of lateral portals in roentgen therapy. 12. Therapy given in one carefully planned series, and not repeated. 13. Long interval allowed to elapse between intensive roentgen therapy and radium therapy. 14. No intravaginal or perineal roentgen therapy administered."

An analysis is given of 149 consecutive unselected cases treated during the years 1936 to 1940, inclusive. The technic was individualized. Although roentgen therapy was usually given, the most effective part of the treatment was carried out with carefully placed radium applicators. In this series there were only four patients with complications possibly due to irradiation. The percentage of patients who were symptom-free with no evidence of cancer from two to six years later was 43.2 per cent. This corresponds favorably with published statistics of others. L. W. PAUL, M.D.

An Instrument for Inserting Multiple Capsules of Radium within the Uterus in the Treatment of Corpus Cancer. J. F. Nolan and A. N. Arneson. Am. J. Roentgenol. **49:** 504–515, April 1943.

There is general agreement that an intra-uterine tandem of radium capsules is ineffective in most instances in the treatment of cancer of the body of the uterus. This is due to variations in shape of the cavity as a result of the tumor and the difficulty of irradiating all parts of the neoplasm equally. The effectiveness of the radium treatment may be increased by the use of a greater number of sources of radiation placed irregularly throughout the uterine cavity. Heyman's technic presents definite advantages. For this method, small, weak intra-uterine tubes are so constructed that an appreciable distance is obtained between the emanating source and the outer wall of the applicator. These tubes are packed singly into the cavity until all available space has been filled.

The authors' technic is a modified form of Heyman's method. Brass tubing was used to make sheaths of equal external diameters but different lengths. The longer ones contain 12.5 mg. sources of radium while the shorter ones hold 6.0 mg. in removable platinum cells. A special applicator has been devised for inserting these capsules into the uterus.

A preliminary report is made on the results of treatment of 69 patients seen during the period 1938 to 1941, inclusive. A notable decrease in the incidence of persistent carcinoma has been observed in those patients treated by the multiple capsule technic as compared with those treated with an intra-uterine tandem. For the multiple capsule method there has been an increase in the total amount of radiation employed but a considerable decrease in the dose contributed by each individual source. This has resulted in less necrosis and fewer other sequelae. The uterus is known to have been perforated in one instance. In so far as possible the radium treatment has been followed by hysterectomy and the gross specimen obtained at operation has supplied material for studying the effects of the irradiation. Each patient treated with multiple capsules has been studied by means of a roentgenogram taken while the radium was in place, and this has been of value in the attempt to improve the technic. Some of the roentgenograms are reproduced. L. W. PAUL, M.D.

Experiences with Roentgen Irradiation Following Operation on Brain Tumors. S. N. Rowe and H. W. Jacox. Am. J. Roentgenol. **49:** 480–486, April 1943.

The authors discuss their experiences with roentgen irradiation of gliomas of the brain following operation on the basis of a series of 32 cases; 21 of these were proved, while in the remaining 12 there was strong presumptive evidence of such a lesion. In some of the cases it was difficult to determine how much of the result was due to the operation and how much to the irradiation, but as far as could be judged, about half the patients were definitely benefited by surgical removal of the tumor or by decompression. The roentgen treatment consisted usually of exposures of 100 to 200 r given daily for approximately three weeks. If the patient's general condition and the tolerance of the scalp would permit, amounts up to 3,400 r measured in air, to one portal, and totals of 7,700 r divided among four portals were given. Subsequent series were administered chiefly when the beginning of a clinical decline indicated their need.

In approximately one-half the patients, worthwhile prolongation of comfortable and useful life occurred. In the remainder the course of the disease was not influenced by the roentgen therapy. In some of these the tumor was apparently unaffected by irradiation and continued its rapid growth. In others the patients could not tolerate sufficient treatment because of the far-advanced nature of the lesion. The best results of the combined surgical and roentgen therapy seemed to be obtained when most of the tumor was removed and intensive irradiation given without dangerously increasing the intracranial pressure.

L. W. PAUL, M.D.

Secondary Lymphosarcoma of the Stomach. F. Buschke and S. T. Cantril. Am. J. Roentgenol. **49:** 450–454, April 1943.

The authors report a case of lymphosarcoma of the neck involving the right tonsil. Roentgen therapy led to complete disappearance of the primary lesion. About a year later the patient noticed a swelling of the legs and complained of some general abdominal distress. Both roentgen examination and gastroscopy showed a large ulcerating lesion on the greater curvature. The lesion was circumscribed and seemed to consist of multiple submucous nodules. The patient received 2,850 r measured on the skin in twenty-seven days. Roentgenoscopy, five days after completion of treatment, showed practically a normal stomach and this was confirmed by gastroscopy. The authors are of the opinion that this type of secondary gastric lymphosarcoma is more common than is generally

recognized, since it is likely to be obscured clinically by the presence of abdominal lymph node metastases.

L. W. PAUL, M.D.

Lymphadenoma and Leukaemia. A. Wilson Gill and A. J. McCall. Brit. M. J. **1:** 284–285, March 6, 1943.

The authors present a case of lymphadenoma which was followed shortly by lymphoid leukemia and discuss the generic relationship of the two diseases.

In the case recorded there was enlargement of the lymph nodes in the neck, axilla, and groin, and roentgenograms showed mass formation about the aorta. Both this mass and the enlarged nodes responded promptly to radiation therapy and the patient was symptom-free for two years. A sudden dramatic change then became evident, with extreme anemia, an increasing leukocyte count, and a high proportion of lymphocytes. Death ensued shortly thereafter. Necropsy was not permitted. Similar cases are cited, one of which was of the myeloid type.

It has been suggested by some authors that the use of irradiation may bring about a leukemic change. The authors, however, express considerable doubt on this point. They feel that lymphadenoma and leukemia are members of a larger group of closely related diseases—the reticuloses.

Q. B. CORAY, M.D.

Infiltration of Bone with Spontaneous Fracture in a Case of Chronic Myelogenous Leukemia. L. M. Meyer, A. B. Friedmann, and V. Ginsberg. Arch Surg. **46:** 514–517, April 1943.

A white woman aged 52 was seen by the authors two years after a diagnosis of chronic myelogenous leukemia had been made elsewhere. The spleen and liver were enlarged and the patient complained of weakness and backache. The white cell count was 110,000. Roentgenograms of the bones showed no abnormality. Irradiation to the kidneys and spleen, repeated from time to time, produced some benefit, but about one year after her first visit the patient re-entered the hospital acutely ill. The white cell count was elevated to 105,000 and a tender mass was present in the right thigh. A pathological fracture occurred ten days later and roentgenograms showed medullary destruction. Biopsy revealed infiltration with myeloblasts and myelocytes. Further irradiation was given, with some fall in the white cell count, but the course was rapidly downhill and death ensued about three and a half years after the original diagnosis.

The authors point out the need for repeated and complete skeletal examinations in cases of chronic leukemia.

LEWIS G. JACOBS, M.D.

Hemangioma of Joints. M. C. Cobey. Arch. Surg. **46:** 465–468, April 1943.

The author adds to the previously reported cases of hemangioma of the knee joint (see Bennett, G. E., and Cobey, M. C.: Arch. Surg. **38:** 487–500, 1939) 4 new examples. The condition is often mistaken for early tuberculosis or injury, since the principal sign is swelling of the joint. A family history of hemangioma, the presence of hemangiomas elsewhere on the body, intermittent attacks of swelling and reduction of size on elevation of the extremity are the cardinal signs of this condition. If the tumor is pedunculated, excision is the treatment of choice; otherwise roentgen therapy should be used. The technic advocated is not described here, beyond the statement that the treatment "usually requires about one week." Weight-bearing should not be allowed for the next three months, "because roentgen therapy may do damage to the growing epiphyses in a child."

In one of the cases recorded here a pedunculated tumor was successfully excised. Roentgen therapy was employed in the other three after the diagnosis was established by biopsy and the lesion was found to be too extensive for surgical removal. Results were good in all, though one patient was followed only a few weeks.

LEWIS G. JACOBS, M.D.

NON-NEOPLASTIC DISEASE

Roentgen Therapy of Non-Specific Inflammatory Affections. A. Rosselet and R. Humbert. Schweiz. med. Wchnschr. **73:** 393–398, March 27, 1943.

After some general remarks and a historical review, Rosselet points out that the early confusion between the treatment technics appropriate for cancer and those appropriate for inflammatory conditions has led to poor results in the latter, since greater doses are required for destruction of the radioresistant neoplastic cells than are necessary in inflammations. Furthermore, the prolongation of the time spread, advantageous in cancer, is not satisfactory in inflammatory lesions, since a previous modification of the vascular bed by bacterial toxins exists. The heavy cancericidal dose frequently repeated must therefore be replaced by a single dose of the right size, or by multiple doses of small size, judiciously spaced. This dose may be as small as 6 r; it usually varies between 50 and 150 r. A single treatment may result in a cure; if repetition is necessary, a three-day interval should be allowed, especially if the inflammation be acute. The voltage may be varied with the depth of the lesion, but need not exceed 180 kv.; it should rarely be less than 50 kv. Filtration may vary from none at all to 3 mm. aluminum or 0.5 mm. copper; F.S.D. between 30 cm. and 1 meter. Many authors oppose sharp limitation of the field, believing that the absorption of x-rays in the skin has a relationship to cure. This is not improbable. In the authors' service, a dose of 100 to 150 r (each time) is given, with factors of 180 kv., 4 ma., 0.5 mm. copper filter, and 30 cm. F.S.D. Not over three treatments in five or six days are given. The general rule holds, that the more acute the inflammation the less the dose.

The authors summarize the results reported in the literature, dividing the field into five groups of cases: the suppurative affections, affections of the joints, of the eyes, genital apparatus, and bronchopulmonary tree. In general, the reported results have been good. In 291 assorted cases treated by the authors the response has been favorable in most instances.

The mechanism of the beneficial result of irradiation is still doubtful. In view of observations on irradiated furuncles, it seems as if the course of the inflammatory reaction may be hastened by irradiation. Since this effect is evidently not a direct one on the bacteria, it seems probable that effects on the white blood cells are responsible. The phagocytic power of human blood cells was tested both with and without previous irradiation, and it was, in fact, demonstrated that the opsonic index rose with doses of radiation up to 75–150 r, but fell with higher doses until, with 300 r, it was

lower than the value for unirradiated controls. Nevertheless, since many competent observers differ in the interpretation of the mechanism by which the results are produced, it does not seem profitable to debate the point; the latter speak for themselves. It is also true that certain reactions—shock reactions—play a part in the observed result. To paraphrase Pascal: "Do not rationalize the game—play it!"

LEWIS G. JACOBS, M.D.

Treatment of Myasthenia Gravis with the Roentgen Ray. C. D. Aring. Ohio State M. J. **39:** 241–243, March 1943.

Following the work of Blalock, Harvey, and Lilienthal, which demonstrated the relationship of thymus gland tumors to the syndrome of myasthenia gravis, the author attempted to treat this condition with deep roentgen therapy. He presents 3 cases, in women who showed well advanced symptoms of the disease.

The first patient had a mediastinal mass which appeared to measure about 5 cm. in diameter. She was given a total of 5,400 r, 1,800 r to each of three ports (10 × 10 cm.) over the left chest. This was followed by a complete remission for three years, after which the patient was readmitted (November, 1941) because of dyspnea and substernal pain, though there was no evidence of muscular weakness or fatigability. Another course of therapy, totalling 4,000 r, was given and there had been no return of symptoms at the time of the report.

The second patient showed no evidence of mediastinal tumor. She was given 2,400 r over the mediastinum, but although she experienced subjective improvement, there was no reversal of the neurological signs. Death from an intercurrent infection occurred four months after treatment. No thymus tissue was found at autopsy.

The third patient had a history of myasthenia gravis since 1940. On re-examination in April 1942, a mass, 3 × 2 cm., was demonstrated in the superior mediastinum. Twelve treatments, totaling 1,900 r, were given through an anterior and a posterior port, with noticeable improvement. Although complete reversal of all the neurologic findings was not obtained, fatigability and weakness almost disappeared, and the patient was able to carry on her usual household duties well, without accessory medication.

Complete technical factors of treatment are not given in this article. The author believes that irradiation is the treatment of choice and should certainly be tried before the more hazardous surgical procedure of thymectomy is attempted.

SIMON POLLACK, CAPT., M.C.

TECHNIC

Production and Characteristics of 3,000 Kilovolt Roentgen Rays. J. G. Trump and R. W. Cloud. Am. J. Roentgenol. **49:** 531–535, April 1943.

By means of the Van de Graaff type of electrostatic high-voltage generator, the authors have been able to produce roentgen rays at steady constant voltages up to 4,000 kv., using air at 13 atmospheres pressure as the insulating medium. The voltage source consists of a rounded high-voltage terminal, about 2 feet in diameter, supported from the ground by a column structure of alternate insulating and metallic spacers. An insulating belt travels at high speed within the column and transfers electric charge continuously between ground and terminal. The assembly is mounted within a metal pressure tank, so that by compression of the gas, the electrically charged belt, terminal, and column may be insulated with a medium superior to air at ordinary pressure. In operation negative electric charge is sprayed on the insulating belt at its lower end and hauled up into the high-voltage terminal, which acquires a negative potential relative to ground in direct proportion to the stored electric charge. The distribution of the ionization produced by roentgen rays over the voltage range of 1,000 to 4,000 kv. has been investigated with this apparatus.

The most outstanding characteristic at these voltages is the progressive movement of the region of maximum ionization to a depth farther below the surface as the voltage is increased. This phenomenon is termed the "subcutaneous effect" and is hardly apparent at 200 kv. It is due primarily to the increase in the number of secondary electrons in the beam as it penetrates and traverses the phantom material. The range of secondary electrons, which is negligible at 200 kv., becomes sufficient at 1,000 kv. to move the depth of maximum ionization several millimeters below the surface. Studies of depth intensity at distances of 70 centimeters and a 10 by 10-cm. field show a steady increase with voltage from 32 per cent at 200 kv. filtered with 0.5 mm. of copper to 57 per cent at 4,000 kv. filtered with 20 mm. of lead and 5 mm. of copper.

L. W. PAUL, M.D.

Subcutaneous X-Ray Therapy: Preliminary Communication. T. A. Watson. Brit. J. Radiol. **16:** 113–114, April 1943.

Subcutaneous tumors, such as cervical lymph node metastases, are treated by incising the skin, dissecting it away, and irradiating the exposed node. In this manner a lethal dose may be given to the metastatic lesion without injury to the skin. The wound is closed without drainage.

The advantages are: a dose in excess of skin tolerance may be given; treatment is given to a single field; there is no skin reaction; an even dose is given to the surface of the node; an unirradiated blood supply is left over one surface of the tumor; the entire treatment is completed in one sitting.

The same principle may be applied to lymph nodes elsewhere, as in the axilla and groin.

SYDNEY J. HAWLEY, M.D.

Time Factor in Irradiation. G. M. MacKee, A. Mutscheller, and A. C. Cipollaro. Arch. Dermat. & Syph. **47:** 490–497, April 1943.

The biologic response of living substances to x-rays is affected by the rate at which the radiation is given. This factor was studied by Holthusen, who plotted a curve of equivalent effects. As an example he found that equivalent erythemas were produced by 500 roentgens of high-intensity rate and 2,300 roentgens of low-intensity rate.

Various investigators have agreed and disagreed with Holthusen's findings. They are confirmed by the authors, using equivalent cutaneous reactions on the same patient as a basis for their experiments.

JOSEPH T. DANZER, M.D.

EXPERIMENTAL STUDIES

Effect of Roentgen Rays Upon the Growing Long Bones of Albino Rats: Histopathological Changes Involving Endochondral Growth Centers. C. L. Hinkel. Am. J. Roentgenol. **49:** 321–348, March 1943.

In one group of experiments by the author only female rats of normal weight and thirty days of age were irradiated. The dose was constantly 600 r (minimal stunting dose) in one sitting. The area irradiated was the right distal femoral growth center. Histopathological studies were made at sixty hours, one week, two weeks, one month, six weeks, two months, and at longer intervals. The findings at each interval after treatment are given in considerable detail. At sixty hours the entire cartilage zone is increased in thickness. This increase appears to be due to swelling of the cells. There is disorientation of osteoblasts. In the marrow spaces, there are haziness of many cells and swelling, pyknosis, and karyolysis of the marrow constituents.

At one week there are swelling of the cartilage cells and disarrangement of the cartilage columns. Marked changes are apparent in the marrow adjacent to the proximal cartilage prolongations. There is a decrease in the number of osteoblasts. Osteoid tissue in the irradiated metaphyses appears to be decreased in amount and unevenly distributed. Gross measurements at this interval show no stunting.

One month after the irradiation injury there is a significant return toward a normal appearance of the cartilage zones. The outstanding abnormality is now found in the metaphyseal and diaphyseal new bone, which is unevenly spaced and composed of spicules considerably wider and longer than normal. Gross measurements at this interval show between 1 and 1.5 mm. stunting of the irradiated femora.

Two months after irradiation there is almost complete restoration of the columnar arrangement of the cartilage cells. The marrow appears normal. Certain residual abnormalities are apparent, but these are noticed only on careful scrutiny.

Studies were also made for the purpose of examining the factors which govern the microscopic findings in any given section and considering how they exert secondary effects on each other. The most important of these factors are probably dose, age of animal at time of irradiation, and length of interval between irradiation and necropsy. In animals of the same age the effect is proportional to the dose administered, both in gross stunting and microscopic changes. In general, the degree of microscopic and gross change is inversely proportional to the age of the animal irradiated.

Probably the histopathological changes can best be explained on the basis of an immediate direct effect and a secondary or indirect influence. It appears logical to assume that the early mainfestations of swelling, granularity, and loss of columnar arrangement noted very soon after exposure to roentgen rays are manifestations of direct irradiation effects upon the cartilage cells themselves. Direct effects may also account for the increased amount and granularity of the intercartilaginous matrix substance. There is no reason to doubt that the effect upon the end capillaries is a direct one. The temporary retardation of growth by roentgen irradiation produces certain modifications apparently identical with those "lines of growth arrest" resulting from other causes. Irradiation effect on the blood vessels produces not only a relative anoxemia but also interference with mechanical erosive function. Avascular areas correspond to unresorbed cartilaginous remnants and these bear a close resemblance to those found in identical situations in healing rickets. Cartilage cells possess amazing powers of regeneration. If a sufficiently long time is allowed to elapse, the surviving cells regenerate and migrate distally to form a new functioning epiphyseal line. In the interval after irradiation there is a very close correlation between blood vessel recovery or regeneration and return of various growth functions. The return to normal histology is much more prompt in young animals and in the portions of the cartilage plate closest to the periosteal vessels.

Stunting, when it occurs, is apparently the result of temporary retardation or cessation of cartilage growth in a distal direction. A "line of growth arrest" is produced. This is similar to that described following acute disease in early childhood. More lasting secondary effects are explained on the basis of injury to vessels, osteoblasts, and marrow cells. At various intervals the cartilage cells tend to resume their normal relations with each other, so that months later any abnormal appearance is lost. The amount of osteoclasis and chondroclasis, which occurs proximal to the advancing line of cartilage columns, and the degree of normal anatomical restitution are directly proportional to the completeness of marrow and vascular regeneration. There is augmentation of mineral deposition in the matrix substance soon after irradiation. The metaphyseal region of bones growing after irradiation contains more mineral and more bone than normal. Study of the modifications induced in cartilage growth, matrix mineralization, osteogenesis, chondro- and osteoclasis, and blood vessel invasion may contribute to an understanding of the dynamics and physiology of bone growth.

CLARENCE E. WEAVER, M.D.

Lung Tumours in Mice and Man. J. Argyll Campbell. Brit. M. J. **1:** 179–183, Feb. 13, 1943.

This is a rather comprehensive article on the relation of lung tumors to various irritating agents, demonstrating a definite relation between the findings in experimental mice and man. There is a detailed discussion of the morphology of lung tumors and also the time factors or age influence and the importance of susceptibility and heredity. A number of tables show the relative etiologic importance of various chemical agents, the most dangerous of these being radium, arsenic, a nickel dust mixture, and chromates of iron and silica. From the results obtained by research it is obvious that, so far as many of the causes of the increase in lung tumors are concerned, mice and men show a very fair agreement. The processes are of a prolonged chemical nature.

In checking the question of mechanical irritation a great deal of microscopy was done and four main degrees of deposit were demonstrated. It is apparent that dusts produce hypertrophy of lymph tissue, but there does not seem to be a very close agreement between the degree of dust deposit and the increase in lymph tissue. Bituminous coal dust and hard

steel grindings seem to be the greatest offenders, but it is apparent that the heavier degrees of dusting in the main do not control the production of lung tumor.

As regards age and sex, it seems that lung cancer is a disease of the closing years of life and males are more often affected than females. This is probably due to environmental conditions. The questions of heredity and susceptibility seem quite important in mouse experimentation, in that inbreeding leads to very susceptible or very resistant strains. One concludes therefrom that a very susceptible individual living in a moderately dusty atmosphere may be affected, while a resistant individual in a much dustier environment will escape. Q. B. CORAY, M.D.

Effect of X-Rays on Cells Cultivated in Vitro. Part II. Recovery Factor. L. Lasnitzki. Brit. J. Radiol. **16:** 61–67, February 1943.

In Part I of this study (Brit. J. Radiol. **13:** 279, 1940), it was shown that irradiation of hanging drop cultures of chick fibroblasts with a dose of 100 r caused first a diminution in cell division, followed by a renewal of mitotic activity accompanied by an increase in the number of degenerate cells. At the same time the ratio of cells in different stages of mitosis was disturbed, with a predominance of cells in prophase.

In this study, also on tissue cultures of chick fibroblasts, two different doses of x-rays were used, and previously irradiated cultures were subjected to a second dose. It was found that larger doses of x-rays caused the same qualitative changes as described in Part I, while the quantitative effect was increased.

When cultures were subjected to a second dose identical with the first, after recovery had apparently taken place, the effect of the second dose was greater than that of the first. The longer the interval between the irradiations, the more nearly the effect of the second dose approached that of the first.

SYDNEY J. HAWLEY, M.D.

Effect of Ionizing Radiations on the Broad Bean Root. L. H. Gray and John Read. Brit. J. Radiol. **15:** 11–16, 39–42, 72–76, 320–326, 1942.

In stating the aim of their experiments, in the first of this series of papers, the authors say: "We have therefore decided to obtain mortality-dose curves for the broad bean root irradiated by gamma rays, fast neutron radiation, alpha particles, and x-rays, intending to use a sufficient number of beans to reduce statistical uncertainties to a reasonable degree, and then to study the effect of combining sublethal doses of pairs of radiations, hoping that by comparison on the one hand with studies of the influence of ion density on the changes produced in specific cell structures such as chromosomes, and on the other with the influence of ion density on chemical changes, it may become clear to what extent each type of effect contributes to the death of the root." The second paper is devoted to the lethal action of gamma radiation, the third to neutron radiation, and the fourth to alpha radiations. The experiments are fully described and the method of analyzing the results is given in detail.

The mean lethal dose for gamma rays was found to be 651 ± 46 energy units (or roentgens); for neutrons 75 ± 16 energy units; for alpha radiation 72.3 ± 2.7 energy units. Thus, when compared on the basis of ionization per unit volume of tissue, alpha radiation is about equal in efficiency to neutron radiation and nine times as efficient as gamma radiation in killing the root.

Unfortunately, since the work is apparently of fundamental importance, the papers do not lend themselves to adequate abstracting.

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